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EARTH SCIENCES

No. 13

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JPRS 77644

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USSR REPORT

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UDC 551.509.313

MODELING OF ANNUAL VARIATION IN CLIMATIC MODEL WITH FEW COMPONENTS

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 16, No 11, 1980 pp 1133-1143

KURBATKIN, G. P., KRUPCHATNIKOV, V. N., LENSKINOV, N. I., Computation Center, Siberian Department, USSR Academy of Sciences, manuscript submitted 28 Nov 79

[Abstract] The authors examine multilevel (6 and 8 levels from 1000 to 10 mbar) hydrodynamic models taking into account the ozone mechanism in the stratosphere and the influence of the ocean. On the basis of the results of comparison of the predicted values of meteorological elements with the actual data an attempt is made to evaluate the relative importance of two factors -- radiation heating due to the absorption of short-wave radiation by ozone and the effect of planetary waves generated in the troposphere -- in the variability of elements of stratospheric circulation. It is shown in the article that the use of general circulation models with few components in the modeling of the annual variation in the example of 1969-1970 demonstrated the capacity of such models to reproduce the most significant components of the annual variation for a specific year, that is, the annual and semiannual harmonics in the temperature field and the annual harmonic of the zonal wind. However, the amplitude of the second harmonic of the wind field is substantially less than the actually observed value. The finer temporal structure of a specific year cannot be reproduced in all sectors of the annual variation; more detailed models make it possible to eliminate these shortcomings. Modeling of the annual variation of temperature anomalies of the ocean surface indicated that the principal peculiarity in the behavior of the anomalies, that is, their attenuation from winter to summer, is reproduced rather well. It was discovered that radiation factors associated with heating of the ozone layer and the dynamic factors responsible for the propagation of planetary disturbances from the troposphere play an unlike role for different time scales of stratospheric circulation. The role of radiation factors is most important in the reproduction of annual and semiannual harmonics, whereas in the case of a sudden warming of the winter stratosphere the role of dynamic factors is more important. Figures 6; references 24: 12 Russian, 12 Western. [37-5303]

UDC 551.581:551.509

METHOD FOR PREDICTING CLIMATE FOR DIFFERENT PERIODS IN ADVANCE

Baku IZVESTIYA AKADEMII NAUK AZERBAYDZHANSKOY SSR: SERIYA NAUK O ZEMLE in Russian
No 2, 1980 pp 44-57

SHIKHLINSKIY, E. M.

[Abstract] The expressions derived in this article and also cited in the author's earlier studies in both graphic and tabulated forms show that the earth's climatic field has interesting peculiarities and well-expressed correspondences between the quantity of solar radiation incident on the outer boundary of the atmosphere and mean air temperatures, precipitation, total solar radiation, radiation balance and total cloud cover at different latitudes. The author postulates that the present-day climatic regime and weather phenomena on our planet are solarly induced and the slightest fluctuations in the solar radiation incident on the outer boundary of the atmosphere in its interaction with all the earth's geospheres cause appreciable changes in weather and climate. It is contended that fluctuations and changes in climatic conditions have a very rhythmic nature, that is, have a different duration and different amplitude. The author's research has been directed to finding ways to detect indicators of a prognostic nature in changes and fluctuations of climatic elements. There is full basis for asserting that such an approach, that is, examination over a long-term period of changes in some climatic element (and not only climate) in a continuous seasonal sequence is the most productive method for detecting the patterns existing in nature with well-expressed prognostic criteria. On the basis of his "earth's climate - mobile equilibrium" theory, in which complex stochastic interrelationships predominate, and applying the method of writing climatic correlation equations, the author has succeeded in deriving rather satisfactory correlations between the quantity of precipitation, air temperature and the Wolf number both for a particular locality (such as Baku, Tbilisi, Astrakhan') and between the precipitation of the particular locality, the temperature of Leningrad and Wolf numbers, averaged for 11- and 5-year solar cycles. These correlations can be used for predicting the annual sums of precipitation as an average for 10 and 5 years with a probability exceeding 60-70%. Equations are derived which make it possible to precompute the quantitative indices. Using climatic equations for mean temperature and the quantity of precipitation (averaged for 11-year and also 5-6-year solar cycles) it was possible to derive equations of a prognostic nature for the four most long-series meteorological stations located in different latitude zones: Leningrad, Astrakhan', Baku, Tbilisi. An example is given to illustrate the technique for writing the prognostic correlation equations. The results of the predictions are regarded "satisfactory to good." Tables 4, figures 5; references: 7 Russian.
[52-5303]

UDC 911.2:551.583:551.588.7

ANTHROPOGENIC CHANGE OF CLIMATE

Moscow IZVESTIYA AKADEMII NAUK SSR: SERIYA GEOGRAFICHESKAYA in Russian No 6, 1980
pp 7-18

BUDYKO, M. I., State Hydrological Institute

[Abstract] Whereas the influence of natural factors on recent climate is characterized by changes in mean global temperature of tenths of a degree, anthropogenic factors in the course of several decades can change this temperature by several degrees, that is, by a value corresponding to the differences between the climate of the glacial and interglacial epochs. Such a change in climate will lead to major changes in the entire environment and will exert a profound influence on man's economic activity. The principal factor in anthropogenic changes in climate is an increase in the concentration of atmospheric carbon dioxide, for the most part as a result of combustion of ever-increasing quantities of fossil fuel. An increase in the concentrations of a number of gases constituting small admixtures to the atmosphere will also exert some influence on the climate of the future. Assuming the prediction of climatic conditions of the future to be a highly important task of modern atmospheric science, it is noted that this problem essentially involves computation of anthropogenic changes of climate, since its natural changes in the near future will be considerably less than the anthropogenic changes. One must bear in mind the conditional nature of any predictions of anthropogenic changes in climate, which in all cases are based on assumptions concerning the further development of economic activity. Climate researchers must evaluate the influence exerted on climate by different scenarios of economic development. The study of the climate of the future must begin with an analysis of those variants which are deemed most probable. The most substantiated assumptions concerning the further development of economic activity lead to the conclusion that in the next 50 years the mean global air temperature will increase by 2-3° in comparison with the preindustrial period, after which the temperature increase will continue for a number of decades. The increase in mean temperature by 2-3° will be accompanied by an appreciable change in precipitation sums and river runoff in a number of regions of the continents and the melting of perennial polar sea ice. In order to meet the demands on climatic information associated with long-range planning it is necessary that the available materials on the climatic regime be supplemented by data on the trends in the change of this regime. Even now data are available on the climatic conditions of the future which can be used for practical purposes, but the extreme inadequacy of such data necessitates a considerable increase in the effectiveness of investigations of impending changes in climate. Figures 5; references 37: 18 Russian, 19 Western.
[56-5303]

UDC 551.583

STATISTICAL PROPERTIES OF A SIMPLE ENERGY-BALANCE CLIMATIC MODEL

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 16, No 12, 1980 pp 1235-1242

GOLITSYN, G. S., DEMCHENKO, P. F., Institute of Atmospheric Physics, manuscript submitted 19 Nov 79, resubmitted after revision 10 Mar 80

[Abstract] On the basis of the diffusion concept of climatic fluctuations the authors have devised a simple model for describing joint random fluctuations of the latitude of the ice boundary and outgoing thermal radiation, averaged for a hemisphere. Use is made of the Budyko zonal model, in a transformed form, with random forces. An Einstein-Fokker equation is derived for the joint probability density function of interannual fluctuations of these global climatic characteristics. With some simplifying assumptions it was possible to compute the time correlation functions and the dispersions of fluctuations of the area of the snow and ice cover and mean global temperature. Empirical data on the intensity and spatial correlation of weather fluctuations are used for numerical estimates of these parameters. The determined values of the dispersions agree with their empirical values. References 14: 6 Russian, 8 Western.
[47-5303]

UDC 551.513.1

THEORY OF A VACILLATION CYCLE OF ATMOSPHERIC ZONAL CIRCULATION

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 16, No 11, 1980 pp 1123-1132

GALIN, M. B., KIRICHKOV, S. Ye., Institute of Atmospheric Physics, manuscript submitted 26 Dec 79

[Abstract] On the basis of a two-level, nonlinear, 14-component model a study was made of atmospheric variations of the "index cycle" type. Using linear theory it is possible to predict the region of existence of vacillation regimes in some interval of external excitation $\sim T^r$ and wave number m. It is shown by numerical integration of the nonlinear system that a vacillation regime arises as a result of loss of stability of a wave with a constant amplitude. The real values of the model parameters lead to vacillation periods close to 10 days. The article gives a detailed analysis of the behavior of zonal and meridional circulation and also the transfer of momentum and heat in the course of the vacillation cycle. Figures 5, tables 1; references 20: 14 Russian, 6 Western.
[37-5303]

CRITICISM OF HYDROMETEOROLOGY INSTITUTE

Moscow PRAVDA in Russian 22 Dec 80 p 3

[Unsigned article]

[Text] The scientific research and design institutes of the USSR State Committee on Hydrometeorology and Environmental Monitoring (Goskomgidromet) have more than 19,000 personnel, including 180 Doctors and 1,440 Candidates of Sciences. The state annually expends tens of millions of rubles on maintaining these institutes and on scientific work. What is the effectiveness of their work? A survey has indicated, as they say, that much leaves to be desired.

Among many scientific groups there is a low discipline in planning and implementation of work. Instead of putting things right, the directors of the Ukrainian and Kazakh Hydrometeorological Institutes have white-washed matters and distorted reports. Other institutes of the State Committee on Hydrometeorology have also systematically exaggerated accounts about the scientific work done and its results.

The scientific level and the quality of research in many cases do not meet requirements. For example, considerable sums are expended on the creation of methodological materials needed in forecasting. However, many methods are not used due to their low effectiveness. The success of long-range forecasts of weather, opening-up of rivers, etc. is especially low.

Little is done to introduce useful innovations into practical work. For example, not one of the innovations of the Central Design Bureau of Hydrometeorological Instrument Making devised during the last five years has been put into industrial production.

The administrations of the State Committee on Hydrometeorology poorly coordinate work, especially on the testing and introduction of new weather forecasting methods. As a result, for example, the basis for preparing monthly summaries still remains the method created almost a half-century ago.

The materials from this survey are being sent to the USSR State Committee on Hydrometeorology and Environmental Monitoring for examination and corrective measures. [50-5303]

5303
CSO: 1865

OCEANOGRAPHY

GEOLOGICAL-GEOPHYSICAL INVESTIGATIONS IN THE PACIFIC OCEAN

Moscow ZEMLYA I VSELENNAYA in Russian No 6, 1980 pp 46-49

NEPROCHNOV, Yu. P., doctor of physical and mathematical sciences

[Abstract] During 1978 and 1979 specialists of the Institute of Oceanology carried out two specialized expeditions in the northern part of the Pacific Ocean (21st and 23d voyages of the scientific research vessel "Dmitriy Mendeleyev"). Twice in the course of three and one-half months they carried out work under the project "Geodynamics of the Northwestern Part of the Pacific Ocean." The work of the expeditions also included study of the earth's lithosphere and asthenosphere, multisided investigations of zones of deep faults, volcanic uplifts, rises and ocean basins and detailed investigations in the region of mass concentration of ferromanganese nodules. Participating in the voyages were scientists of scientific research institutes of the USSR Academy of Sciences, Siberian Department USSR Academy of Sciences, Far Eastern Scientific Center USSR Academy of Sciences and other scientific institutes. During the two voyages of the ship detailed geological-geophysical work was carried out in ten polygons and along two geological traverses, including echo sounding, seismic profiling, magnetometric and gravimetric investigations. The manned underwater vehicle "Paysis" was used for the first time under oceanic conditions on the 21st voyage. (A map accompanying the text shows the track followed by the vessel and the features investigated.) This report describes the investigations made in the northwestern basin, with particular attention to a number of investigated rises and ridges; much information is given on the deep faults which were studied; the northeastern basin is also briefly described. On the 21st voyage the "Paysis" was used in studying the Dmitriy Mendeleyev seamount and Hermit atoll. Data from this vehicle, as well as dredgings and underwater photography, yielded geomorphological and geological proof that in the past this seamount rose above the ocean surface and after sinking was probably subjected to tectonic dislocations. On the outer slope of Hermit atoll the "Paysis" collected unique geomorphological, geological and biological data. For example, it was possible to ascertain the boundary between the coral limestone superstructure with a thickness of about 600 m and the basalt base of the atoll. On the upper part of the slope three scarps were discovered, indicating variations in ocean level associated with glacial epochs. The work of the "Paysis" was supplemented by geomorphological observations on the islands within the lagoon and also echo sounding, underwater photography and geophysical work on the slope and in the basin to the

south and southwest of the atoll. Geologists and geomorphologists were able to interpret the principal stages in atoll formation. On-shore observations indicated that the sinking of the atoll is still continuing. In general, the data collected on the two expeditions serve as a good basis for a clearer visualization of the tectonics and geological history of the northern part of the Pacific Ocean. Figures 3.
[36-5303]

UDC 551.465.62

SPATIAL CHARACTERISTICS OF THE TEMPERATURE FIELD IN THE SARGASSO SEA DURING THE SUMMER SEASON OF 1978

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 16, No 12, 1980 pp 1291-1302

VASILENKO, V. M., GAYDYUKOV, A. A., ZHIKHAREV, G. M., MIRABEL', A. P., Institute of Oceanology USSR Academy of Sciences, manuscript submitted 28 Aug 79, resubmitted after revision 5 Feb 80

[Abstract] In the analysis of observational data obtained from self-contained buoy stations at depths of 400 and 700 m during the POLIMODE hydrophysical expedition the authors use the method of empirical orthogonal functions which makes it possible to describe the spatial structure of the temperature field. The effectiveness of use of this method is attributable to the quite high rate of convergence of expansions of records of the low-frequency component of temperature fluctuations in eigenfunctions of a correlation matrix constructed for each month separately. For example, the contribution of the first term of the expansions is more than 50% of the total dispersion and the concentration of information in the first three terms is more than 90%. For the 700-m horizon the convergence rate is somewhat higher than for the 400-m horizon. An analysis of the most informative first modes of the empirical orthogonal functions (jointly with the field of dispersions) made it possible to ascertain the distinguishing characteristics of the spatial variability of the macrofluctuations from month to month and thus to predict the regions of the polygon characterized by the greatest fluctuation activity. Figures 5, tables 6; references 7: 6 Russian, 1 Western.
[47-5303]

UDC 551.465.62(261)

CHARACTERISTICS OF TEMPERATURE STRUCTURE OF THE UPPER LAYER OF THE OCEAN IN THE NEIGHBORHOOD OF THE MID-ATLANTIC RIDGE

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 16, No 11, 1980 pp 1220-1225

PARAMONOV, A. N., LEBEDEVA, T. P., NAVROTSKIY, V. V., Marine Hydrophysical Institute Ukrainian Academy of Sciences, manuscript submitted 19 Aug 79

[Abstract] The article describes special measurements made on the 17th voyage of the scientific research ship "Akademik Vernadskiy" on two latitudinal runs across the Mid-Atlantic Ridge, along 31°N and 25°N. The first run was during the period 7-10 December 1977 in a westerly direction and the second was during the period 6-9 March 1978 in an easterly direction. The investigations were made using a "Shleyf" towed complex and involved measurements of surface temperature in the layer 0.5 m, integral temperature and temperature and depth at the free end of the towed distributed temperature sensor. The measurements took in the 200-m surface layer of the ocean. The ship's speed was measured and echo soundings were made. The measured parameters made it possible to compute (at a real time scale) the momentary profiles of the vertical distribution of temperature, determine the depth of the boundary of the seasonal thermocline with a spatial discreteness averaging about 3 km. The principal result of the investigation was determination of the relationship between variability of the temperature field of the upper layer of the ocean in the neighborhood of the Mid-Atlantic Ridge and nonuniformities of bottom relief. The practical importance of this phenomenon is determined by the corresponding variations of the upper boundary of the seasonal thermocline and the possibility of obtaining information on bottom topography from the characteristics of surface temperature and other oceanographic parameters such as radiobrightness temperature, the color index of water, etc. Figures 4; references 11; 7 Russian, 4 Western.
[37-5303]

UDC 551.465.45

CHARACTERISTICS OF VERTICAL STRUCTURE OF DEEP CURRENTS IN THE NEIGHBORHOOD OF THE 'POLIMODE' EXPERIMENT POLYGON

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 16, No 12, 1980 pp 1326-1330

VASILENKO, V. M., MIRABEL', A. P., Institute of Oceanology USSR Academy of Sciences, manuscript submitted 28 Aug 79

[Abstract] The authors give the results of direct instrumental measurements of currents made on the 27th voyage of the "Akademik Kurchatov" during the POLIMODE experiment in the western part of the Sargasso Sea. BPV automatic current recorders

were installed at the horizons 90, 400, 705, 2080, 3120 and 4170 m at 29°19'N, 68°63'W during the period 1 August-10 October 1978 (measurement interval 1 hour). Significant changes were observed in the vertical profiles in the layers of the seasonal thermocline (to 200 m) and small vertical temperature gradients 200-500 m or in the layer of the main thermocline (more than 500 m) to a depth of 1000 m; then, with an increase in depth, the profiles do not change form, retaining their values constant or slowly decreasing. These profiles indicate that the vertical structure of the low-frequency oscillations is formed for the most part by the barotropic mode, or in individual cases, the first baroclinic mode. There was found to be a rather close correlation between fluctuations at different horizons. The discovered correlation between velocity fluctuations in the deep ocean can be indicative of the possible existence there of a highly barotropic layer in which dynamic processes develop actively. Such characteristics of deep structure of the field of currents are also reflected in the monthly variation of the meridional and zonal components. Figures 3, tables 1; references 7: 3 Russian, 5 Western.
[47-5303]

UDC 551.465

STRATIFICATION OF HOT BRINES IN THE ATLANTIS-II DEPRESSION

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 255, No 2, 1980 pp 458-462

MONIN, A. S., corresponding member USSR Academy of Sciences, PLAKHIN, Ye. A., STUNZHAS, P. A., Institute of Oceanology USSR Academy of Sciences, manuscript submitted 15 Jul 80

[Abstract] The brine in the Atlantis-II depression has a stable density stratification (due to the high salinity of the outpouring juvenile waters) and is constantly heated from below by a heat flow from the sedimentary layer and high-temperature periodically outflowing brines. The authors observed conditions in this depression which were close to a laboratory experiment described by Turner: stable salinity stratification and a constant heat flow from below. Recent hydrophysical investigations by the Institute of Oceanology aboard the "Akademik Kurchatov" (March 1980) for the first time made it possible to measure the vertical distribution of temperature and conductivity in the Red Sea depressions and obtain additional information concerning stratification and spatial-temporal variability. In the Atlantis-II depression there is a clearly expressed temperature-salinity stratification of the brine in five steps. T-S diagrams were constructed for the waters in the four depressions; these clearly illustrate the different nature of brines in the depressions. There the temperature of the outpouring waters exceeds 300°C. The mass of hot and saline water convectively rises upward, passes through the boundary of the upper and lower brines, and after cooling to a temperature of about 240°C its density is equal to the density of the upper brine. Upon cooling, this mass descends to the boundary of the upper and lower brines and possibly forms the upper brine layer in the Atlantis-II depression. Further passage of heat through the discontinuity of the lower and upper brines occurs due to the molecular diffusion of heat and a thin stratification of the upper brine begins. Turner postulated that internal waves can be observed in the upper layer of brine. Observations in the Valdivia depression indicated phenomena which can be identified with internal waves. Figures 3, tables 1; references 7: 3 Russian, 4 Western.
[34-5303]

UDC 551.466

HIGH-FREQUENCY SPECTRUM OF WIND WAVES

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 255, No 2, 1980 pp 455-458

LEYKIN, I. A., ROZENBERG, A. D., Institute of Oceanology USSR Academy of Sciences, manuscript submitted 2 Jun 80

[Abstract] Experimental data of recent years show that with approximation of the HF ($\omega > \omega_m$, ω_m is the frequency of the spectral maximum) part of the spectrum of wind waves $S(\omega)$ by a power function in the form $S(\omega) = \alpha\omega^{-n}$ the values of the exponent n differ substantially from $n = 5$, corresponding to the Phillips equilibrium spectrum $S(\omega) = \beta g^2 \omega^{-5}$. For clarifying the influence of long waves on the formation of the HF part of the spectrum $S(\omega)$ the authors made measurements of the frequency spectra of wind waves from a pile base in the Caspian Sea located 20 km from shore (depth 40 m). Twenty $S(\omega)$ spectra were obtained with wind velocities from 3.5 to 13.5 m/sec and waves which were close to well-developed. The employed apparatus, in combination with the method for the processing of data, made it possible to measure the $S(\omega)$ spectra in the frequency range to 10 Hz. The existence of a universal spectrum $S(\omega)$, which describes well all the experimental spectra in a broad range of dimensionless frequencies $\tilde{\omega} = 1.2-30$, indicates that in the initial $S(\omega)$ spectra there are also three corresponding intervals making possible a schematic representation of the frequency spectrum of wind waves $S(\omega)$ in the region $\omega > \omega_m$ in the following form: 1) an interval close to the frequency of the spectrum maximum ($1.2 \leqslant \tilde{\omega} \leqslant 3.2$), where $S(\omega) \sim \omega^{-4}$; in this interval there is evidently an active increase in the spectral components; 2) an equilibrium interval ($3.2 \leqslant \tilde{\omega} \leqslant 10.5$), where the $S(\omega)$ spectrum is described well by the Phillips function with $\beta = 1.4 \cdot 10^{-2}$; the form of the $S(\omega)$ spectrum in this interval is determined, in accordance with the Phillips hypothesis, by the collapse of waves; 3) a high-frequency interval ($\tilde{\omega} > 10.5$), whose form $S(\omega) \sim \omega^{-3.5}$ is determined to a considerable degree by the orbital motion of the long-wave components. Since the study is based on a limited amount of experimental data (only 20 spectra), further experimentation is required. Figures 3; references 13: 8 Russian, 5 Western.
[34-5303]

UDC 551.466.81

HYDRODYNAMIC INSTABILITY IN INTERNAL WAVES OF A TIDAL PERIOD

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 16, No 12, 1980 pp 1331-1333

KUSHNIR, V. M., ANDRYUSHCHENKO, Ye. G., Marine Hydrophysical Institute, Ukrainian Academy of Sciences, manuscript submitted 26 Jun 79

[Abstract] The Richardson number Ri is the most important parameter determining the stability of wave hydrodynamic motion in a stably stratified fluid. In this article the authors evaluate the current Ri(τ) values for different layers of low-frequency internal waves and give the results of an experimental investigation of this parameter on the basis of measurements of current velocity, density stratification and vertical movements of different layers of low-frequency internal waves in the northeastern part of the Atlantic Ocean. An expression is derived which made it possible to compute the minimum Ri numbers which for the depth range 100-300 m were equal to 2-5. The dependence of Ri on time reveals a periodicity with a period of about 6 hours; the spectrum of vertical shifts of horizontal velocity has a clearly expressed maximum for periods of 6 hours. It was also possible to estimate the local Ri(τ) values and their interrelationship to the energy of short-period internal waves. In individual time intervals the Ri numbers can attain critical values. The periods of an increase in Ri correspond to a decrease in W_k and vice versa (W_k is the kinetic energy of wave movement). The identical character of the dependences of change in the normalized energy of fluctuations of current velocity in the ocean on the Ri number obtained in this study and in earlier investigations probably indicates a universality of this behavior. Figures 4; references 12: 8 Russian, 4 Western.
[47-5303]

UDC 532.5:551.465.6

INTERNAL WAVES IN A ZONAL CHANNEL OF VARIABLE DEPTH

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 16, No 12, 1980 pp 1276-1283

BUKATOV, A. Ye., BUKATOVA, O. M., Marine Hydrophysical Institute, Ukrainian Academy of Sciences, manuscript submitted 16 Apr 77

[Abstract] The wave movement of a homogeneous fluid filling an infinitely long rotating channel of a constant depth and width has been thoroughly studied. A similar problem for a channel with a bottom sloping from one wall to the another has also been investigated, as has been the case of a two-layer fluid with the propagation of long waves in a channel with a constant depth and with a stepped bottom. Expanding on such investigations, the authors, in the approximation of the theory of long waves, study the wave movement of a two-layer fluid in a zonal channel with an uneven bottom. The waves are generated by periodic disturbances of atmospheric pressure moving along one of the banks of the channel. The bottom

relief is modeled in the form of an underwater ridge oriented along the axis of the channel with its crest over its axis. In this formulation it was possible to analyze the influence of the underwater ridge, the distribution of atmospheric disturbances in the width of the channel and the place of its axis on the nature of the wave movement and the appearance of internal waves at the free surface. Figures 6; references 10: 9 Russian, 1 Western.
[47-5303]

UDC 551.465.41

VERTICAL MICROSTRUCTURE OF HYDROPHYSICAL FIELDS IN THE EQUATORIAL ATLANTIC

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 16, No 12, 1980 pp 1315-1319

BENILOV, A. Yu., MONIN, A. S. Institute of Oceanology USSR Academy of Sciences, manuscript submitted 15 Nov 79, resubmitted after revision 5 Mar 80

[Abstract] During March-April 1979 the "Akademik Kurchatov" on meridional runs along 18°30' and 23°30'W through the equatorial zone of the Atlantic Ocean (2°N-2°S) carried out measurements of the microstructure of vertical profiles of temperature and conductivity of sea water using an AIST digital probe. A computer was used in calculating the microstructure of the salinity and density profiles of sea water. This article gives some results of these measurements and discusses the characteristics of the temperature, salinity and density profiles. These measurements revealed significant characteristics of the Lomonosov Countercurrent. It was found that the waters of the Lomonosov Current have an increased salinity in comparison with all the westerly currents surrounding it, which makes the salinity field one of the principal hydrological indicators of the Lomonosov Current. This countercurrent is expressed to a far lesser degree in the temperature field. Its meridional axis is situated approximately in the middle of the thermocline and the Lomonosov Current is manifested only in the form of some thickening of the thermocline -- a rising of the upper and a lowering of the lower boundary so that the upper part of the countercurrent is somewhat colder and the lower boundary is somewhat warmer than the waters of the Southern Trades at these same depths. The meridional section of the density field shows that the countercurrent is manifested only in the form of a thickening of the pycnocline. Specific conditions arise at the boundaries of the countercurrent for the development of the vertical microstructure. The upper boundary on the average is at a depth of 15 m in the middle of the upper mixed layer of the ocean, which should impede the existence of any long-lived microstructure there; but here also there are the greatest vertical gradients of current velocity, creating a sharp vertical nonuniformity of the upper mixed layer and capable of favoring the appearance of a short-lived vertical microstructure. Below the core of the countercurrent both temperature and salinity decrease with depth so that they introduce contributions of different signs into the vertical density gradients. This creates conditions for the development of microstructural layers with microconvection in the form of salt fingers as a result of the dual diffusion of heat and salt. Finally, the horizontal nonuniformity along the lateral boundaries of the countercurrent

creates conditions for layer intrusions of the waters of the countercurrent into the Southern Trades zone. The article gives a specific example of the microstructure. Figures 3; references: 4 Russian.
[47-5303]

UDC 550.385:551.466.3

MAGNETIC FIELD INDUCED BY WIND WAVES

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 16, No 12, 1980 pp 1312-1315

BABKIN, G. I., YAKOVENKO, O. I., Pacific Ocean Oceanological Institute, Far Eastern Scientific Center USSR Academy of Sciences, manuscript submitted 24 Oct 79, resubmitted after revision 4 Jan 80

[Abstract] The electromagnetic (EM) fields arising during the movement of sea water in the earth's magnetic field are of practical interest. In this article the authors consider only the magnetic fields associated with surface gravitational waves. The permanent magnetic field quadratic with respect to wave amplitude was computed and the Pierson-Moskowitz spectrum is used in the evaluations. The problem of the movement of a conducting fluid in the magnetic field is described by a system of equations in magnetohydrodynamics which includes equations for the movement of the fluid which take into account the density of electromagnetic forces $c^{-1}[jH]$ and the Maxwell equations in which allowance is made for the relationship between the current j and the field E in moving conductors. The authors examine very simple movements of sea water in the earth's magnetic field H_0 associated with surface gravitational waves. The HO field is assumed to be perpendicular to the surface of a fluid having an infinite depth. The appropriate equations can be easily simplified. The induced (by movement of the fluid) magnetic fields H are considerably weaker than the HO field. An examination of the problem reveals that the influence of electromagnetic fields on movement of the fluid can be neglected. This condition is well satisfied and therefore the hydrodynamic problem of movement of the fluid can be solved independently and the result can then be substituted into the expression describing the electric current j. Then it is necessary to solve a system of Maxwell equations which take into account not only the conductivity current ΔE, but also "stray" currents $c^{-1} \sim [vH_0]$. Under given conditions it is shown that displacement currents can be neglected. It is then found that the electric field E can be neglected. Then the initial problem is reduced to determination of the magnetic field of constant currents. The problem is solved in such a formulation. References 8: 6 Russian, 2 Western.
[47-5303]

UDC 551.465.11

MODEL OF NONSTATIONARY THERMOHALINE CIRCULATION IN AN OCEAN OF FINITE DEPTH

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 16, No 11, 1980 pp 1198-1207

RYABININ, V. E., USSR Hydrometeorological Center, manuscript submitted 19 Oct 79

[Abstract] The author has found a precise special solution for the nonstationary problem of the dynamics of the main oceanic thermocline containing an arbitrary barotropic component of perturbation of hydrostatic pressure. It was found that the peculiarities of distribution of the density field and bottom relief characteristic for the North Atlantic cause a cyclonic rotation of the stationary component of deep currents. The latter leads to upwelling of waters from the very deep layers to the main oceanic thermocline and compensates the diffusional heat flow from above. The nonstationary component of circulation changes the direction of rotation in dependence on the sign of the surface temperature time derivative. An equation is derived describing evolution of the density anomaly in the open ocean. A method for its solution was found. The results of earlier investigations concerning the influence of bottom relief and Ekman velocity on the nature of movement of the anomaly are confirmed. It was found that vertical turbulent exchange intensifies the formation of the front on the leading edge of the anomaly and interaction of the wind with bottom relief leads to the appearance of an insignificant meridional velocity of its movement. Figures 1, tables 1: references 13: 10 Russian, 3 Western.

[37-5303]

UDC 551.466.31

INITIAL STAGE IN THE GENERATION OF WIND WAVES

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 16, No 11, 1980 pp 1214-1217

KRASITSKIY, V. P., Institute of Oceanology USSR Academy of Sciences, manuscript submitted 19 Sep 79]

[Abstract] The Phillips resonance theory is one of the most commonly applied theories of generation of wind waves in the initial stage. In this theory it is postulated that the incipient waves do not change the state of the atmospheric boundary layer and the entire effect of the atmosphere on the water surface is associated with fluctuations of normal pressure. As a result, the wave spectrum is proportional to time t and the spatial-temporal spectrum of pressure fluctuations $\mathcal{P}(k,\omega)$. A far less known fact is that the fluctuations of shearing stresses are dynamically equivalent to fluctuations of normal pressure. However, there has been no spectral theory of generation with allowance for fluctuations of shearing stresses. The author here formulates such a theory on the basis of three-dimensional linear equations with viscosity taken into account. The allowance for viscosity is necessary for the most part in order to satisfy the corresponding boundary conditions. References 5: 2 Russian, 3 Western.

[37-5303]

VOYAGES OF SOVIET RESEARCH SHIPS -- DECEMBER 1979-JULY 1980

Moscow ZEMLYA I VSELENNAYA in Russian No 6, 1980 p 72

[Article by G. Ya. Shcherbakov]

[Text] During the period December 1979-March 1980 there was a joint expedition in the Red Sea involving three ships of the Institute of Oceanology USSR Academy of Sciences -- "Akademik Kurchatov," "Professor Shtokman" and "Akvanaut." The deep-water manned vehicle "Paysis" and other underwater vehicles were used in investigating the rift zone (ZEMLYA I VSELENNAYA, No 5, 1980, pp 53-57).

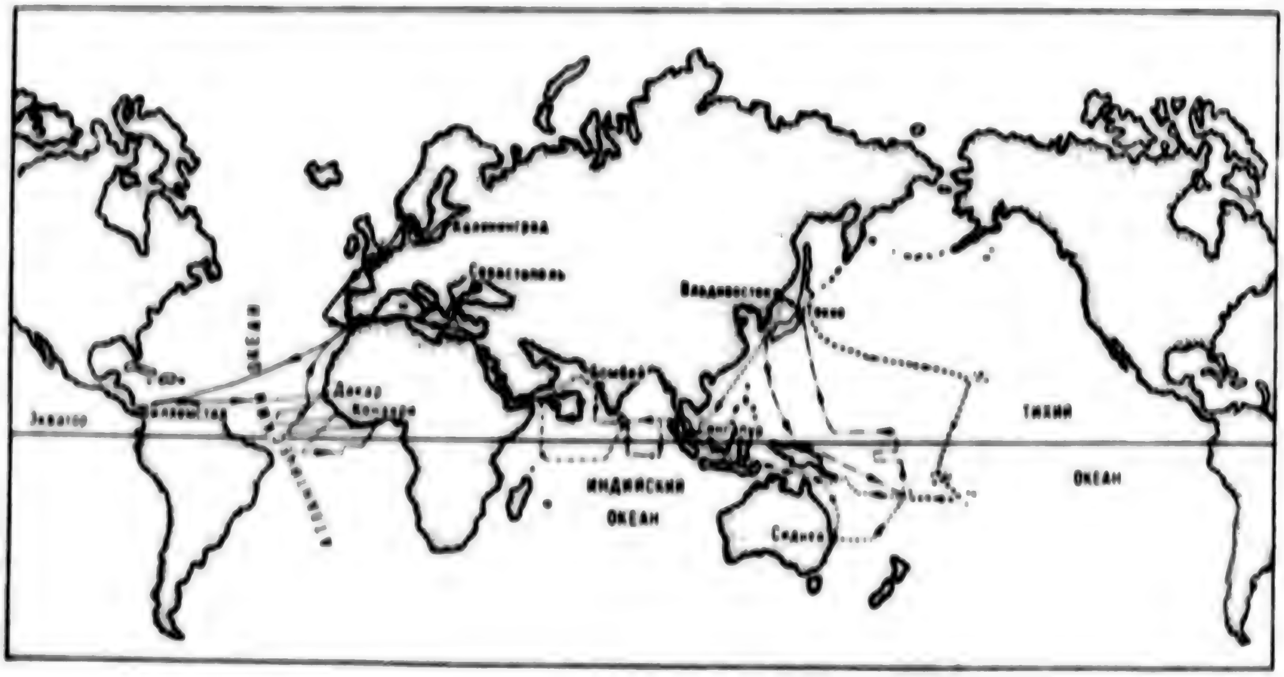
The ship "Dmitriy Mendeleyev," belonging to the same institute, from January through March carried out scientific investigations in the Pacific Ocean, primarily in the equatorial system of currents: a study was made of the variability of hydrological fields, processes of circulation and mixing of waters.

The voyage of the ship "Professor Bogorov" (Far Eastern Scientific Center USSR Academy of Sciences) continued from December 1979 through March 1980 and transpired in the tropical zone of the Pacific Ocean. The scientists engaged in chemical and biological investigations of marine organisms.

A geological-geophysical expedition on the ships "Pegas" and "Morskoy Geofizik" (Sakhalin Multidiscipline Scientific Research Institute) from January through March studied the nature of joining of the lithospheric blocks of Eurasia and the Pacific Ocean under different conditions.

The crew of the ship "Kallisto" (Far Eastern Scientific Center USSR Academy of Sciences) carried out a second multidiscipline expedition under the UNESCO international program "Man and the Biosphere." On the islands of the subtropical and tropical zones of the Pacific Ocean, in particular, from May of this year work has been carried out on the project "Ecosystems of the Islands and Their Rational Use."

An expedition aboard the "Mikhail Lomonosov" (Marine Hydrophysical Institute Ukrainian Academy of Sciences) from October 1979 through February 1980 carried out a thorough study of the waters of the Caribbean-Gulf of Mexico basin. Special attention was devoted to the Gulf Stream -- the most important water artery exerting an influence on climate and commercial fishing in the adjacent waters of the world ocean (ZEMLYA I VSELENNAYA, No 5, pp 53-56, 1965). The program also included expanded investigations along the western shores of Africa on the basis of a joint Soviet-Guinea agreement.



———— "Akademik Kurchatov"
———— "Mikhail Lomonosov"
_ _ _ _ "Professor Vodyanitskiy"
_ · _ · "Kallisto"
------ "Professor Bogorov"
xxxxxx "Dmitriy Mendeleyev"
-x-x-x "Akademik Vernadskiy"

Scientific research work in the northeast Atlantic, on the shelves of the Barents Sea, Norwegian Sea, North and Baltic Seas, was carried out from February through June on the ship "Dal'niye Zelentsy" (Murmansk Marine Biological Institute). Measurements were made of the degree of contamination of waters and sediments and their influence on the primary links of the food chain of marine organisms.

In the Indian Ocean investigations were made on an expedition of the "Akademik Vernadskiy" (Marine Hydrophysical Institute Ukrainian Academy of Sciences). Their program included hydrophysical, hydrooptical, hydrochemical and biological investigations. On a voyage lasting from March through June it was possible to estimate the commercial resources of the Indian Ocean.

An expedition on the ship "Professor Vodyanitskiy" (Institute of Biology of the Southern Seas Ukrainian Academy of Sciences) was carried out on the theme "Macroscale Regionalization of Productivity of the Pelagic Association in the Ocean." The study of the biological resources in the abyssal regions beyond the limits of the 200-mile zones is a timely problem in exploitation of the world ocean. The expedition operated from March through July in the western part of the Indian Ocean.

Members of an expedition aboard the "Akademik Kovalevskiy" (Institute of Biology of the Southern Seas Ukrainian Academy of Sciences) were engaged in a comparative study of the ecology of mass organisms. In the Aegean Sea, the Strait of Tunis, eastern and central parts of the Mediterranean Sea, Adriatic and Black Seas experiments were carried out related to the consumption of food, growth and energy exchange of some fish and invertebrates.

An expedition aboard the ship "Ayu-Dag" (Estonian Academy of Sciences) worked in the Baltic Sea. A study was made of the optical properties of the open part of the sea, the interrelationship between synoptic variability and general circulation of waters.

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[35-5303]

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CSO: 1865

GORSHKOV COMMENTS ON OCEANOGRAPHIC ATLAS

Moscow LITERATURNAYA GAZETA in Russian 24 Dec 80 p 12

[Interview with Admiral of the Soviet Fleet S. G. Gorshkov, commander-in-chief of the Soviet Navy]

[Excerpts] Q: First of all, Sergey Georgiyevich, what do you see as the principal difference between the new ATLAS OKEANOV and earlier publications of this type?

A: The fact is that the ATLAS OKEANOV is based on an enormous, I say this without reservations, a truly enormous amount of primary oceanographic observations, whereas most earlier atlases have been created on the basis of already published textual and cartographic materials. The new ATLAS OKEANOV thoroughly characterizes the state of water layers in the world ocean from the surface to a depth of 5,000 m -- such depths occupy about 80% of the area of the world ocean -- and the atmosphere over it to an altitude of 16-18 km. (Earlier published atlases were restricted to a characterization only of the surface waters and the atmospheric layers in contact with them.) It is natural that for this purpose it was necessary to make extensive use of recent attainments in Soviet oceanographic science and practice and the results of investigations carried out during the post-war years by the oceanographic expeditions of many countries.

Q: It is known that a very great body of seamen and scientific institutes worked on the ATLAS...

A: Yes this is so. The ATLAS OKEANOV for the most part is based on direct oceanographic observations, fundamental studies and experimental investigations by such scientific institutes of the USSR Academy of Sciences as the Institute of Oceanology imeni P. P. Shirshov, Institute of Geography, Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Main Astronomical Observatory at Pulkovo, USSR State Committee on Hydrometeorology and Environmental Monitoring, Moscow University and many other institutes and organizations in the country.

Q: When did work actually begin on the ATLAS OKEANOV?

A: In 1963. The fact is that the existing MORSKOY ATLAS, which had served its important purpose, no longer could satisfy the new needs of science and practical navigation. Accordingly, after the second world war our country developed intensive investigations of the ocean. We can recall, at least, the unprecedented voyages of the legendary science ship "Vityaz'" and other ships of the scientific fleet of the USSR Academy of Sciences. These investigations over the entire expanse of the world ocean were made by the scientists and specialists of the naval, merchant marine and fishing fleets. These investigations included observations made under joint international programs and also data which we received from other countries by way of scientific exchange. More than 7 million oceanographic observations carried out during the last 25-30 years were collected, analyzed and incorporated into a unified system. A total of 30,000 ship logs were studied. Naturally, they were an important component in the compilation of almost 2,500 special maps.

Thousands of people tirelessly worked on creation of the ATLAS OKEANOV and extracted invaluable, truly enormous material. This ATLAS OKEANOV was created primarily for navigation, but it also assists in study of the inexhaustible wealth of the world ocean. In reality, our planet, although it is called the earth, is 70% covered by seas and oceans. Accordingly, their influence is reflected not only in coastal regions, but also in processes in the atmosphere, and accordingly, in climate, and on all the continents surrounding the oceans... Therefore, a knowledge of the highly diverse structure and dynamics of the waters of the world ocean is of great practical value for many aspects of human life.

Q: The two enormous, splendidly printed and bound volumes of the ATLAS OKEANOV truly constitute a unique scientific work, a unique publication! Could you not, Sergey Georgiyevich, at least briefly characterize the structure of the ATLAS OKEANOV?

A: These two volumes are devoted to the Pacific, Atlantic and Indian Oceans, which constitute about 96% of the entire area of the world ocean. Each volume opens with a section entitled "History of Exploration of the Ocean," which familiarizes the user with the progress in study of the particular ocean, beginning with the era of great geographical discoveries and up to the present time. The second section is entitled "Ocean Floor" and gives some idea concerning bottom relief of the ocean, its dissection, geomorphological, tectonic and seismic peculiarities of structure of the earth's crust and bottom sediments (this section for the first time gives original maps which generously enrich world science with information concerning structure of the ocean floor). The third section is entitled "Climate": here there is a discussion of the thermal, water and circulatory regimes of the atmosphere. The fourth section is devoted to the hydrology of the oceans; the maps in this section give a broad hydrophysical description of the ocean. The maps in the next two sections -- "Hydrochemistry" and "Biogeography" -- describe, in particular, the biological productivity of the ocean. The world ocean was, is, and for a long time will remain a focus of enormous wealth whose importance for mankind will increase with each passing day...

Q: What do you have in mind specifically?

A: First, the highly important circumstance that the wealth of the world ocean is virtually inexhaustible. It holds tremendous reserves of industrial raw materials and energy. The ocean is one of the principal sources of food, more and more of which is required by the growing population of the earth.

Now 60 million tons of fish are annually produced in a territory equal to approximately 10% of the area of the world ocean. And in 1985 this catch can be 100-120 million tons. The plant and animal plankton of the ocean, whose supplies are truly enormous, in the long run can become a valuable source of protein. Specialists consider both the chemical and mineral resources of the world ocean to be virtually inexhaustible. It contains approximately 90 billion tons of iodine, about 3 billion tons of manganese, vanadium and nickel, 5 billion tons of uranium, 10 million tons of gold, billions of tons of magnesium, potassium, bromine and calcium, millions of tons of silver, thorium and other rare elements. Very rich concentrations of ferromanganese sedimentary rocks have been found on the ocean floor; these contain about 30 chemical elements, including 25% manganese, 14% iron, and also cobalt, nickel, copper, titanium, vanadium... The ocean floor has enormous reserves of petroleum and gas. Researchers feel that in the next 10 years the annual volume of the marine production of petroleum in the world will attain about a third of its total production...

Q: We have discussed the first two volumes of the ATLAS OKEANOV which have already appeared. What about the third volume?

A: There will be a third. Work on it is already in progress. It can be said that it is almost ready. This volume is devoted to the other regions of the world ocean which were not the object of investigation of the first two volumes. I believe that the work will be completed late in 1981...

Q: We know that the Presidium of the USSR Academy of Sciences, approving the results of the great amount of theoretical work done by the team in creating the ATLAS OKEANOV has recommended that the editorial board which you head and the main editorial office prepare a new scientific-popular atlas CHELOVEK I OKEAN (Man and the Ocean)...

A: It is too early to discuss this, but we are thinking about it. The future atlas CHELOVEK I OKEAN seems to me to be a major popular publication which could be used as well at academic institutions so that young people could be familiarized to a greater degree with this highly complex world which is called the world ocean. [48-5303]

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CSO: 1865

TERRESTRIAL GEOPHYSICS

UDC 553.98:551.34(57.1)

NATURAL GAS HYDRATES IN NORTHWESTERN SIBERIA

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 9, 1980 pp 3-8

TROFIMUK, A. A., MAGOGON, Yu. F., CHEMAKIN, N. M., Institute of Geology and Geophysics Siberian Department USSR Academy of Sciences and All-Union Scientific Research Institute of Gas, manuscript submitted 18 Jan 80

[Abstract] Western Siberia is one of the promising regions where in addition to deposits of free gas there may be concentrations of natural gas in a hydrate state. The region is characterized by a thick geocryological stratum and rather low geothermal gradients. During cyclic coolings and glaciations in the Pleistocene the deposits of free gas associated with zones of hydrate formation at depths of 700-1,200 m or more should pass into a hydrate state. As made clear in this article, a change in the level of heat exchange at the earth's surface and the associated fluctuation of thickness of zones with below-zero temperatures, variations in the temperature gradients in the deep layers and the presence of silicified clays in the sections all could cause the concentration and migration of hydrocarbons in the extreme north of the West Siberian Province. A schematic map of equal depths of the lower boundary of the hydrate formation zone, prepared on the basis of materials from study of the geothermal gradient and geological-hydrogeological conditions, making it possible to tie in the geotemperature field and the tectonic structure of the region, lithological-facies conditions, movement and mineralization of ground water, gives some clarification of the prospects of the sedimentary cover in this region. A particularly promising area is the Obskaya Guba and the adjacent peninsulas whose sedimentary cover is characterized by a small thickness of the perennially frozen layers, an increased heat flow in the central part of the Yamal Peninsula and a decreased geothermal gradient in the peripheral part. It is recommended that reconnaissance work be initiated on the Yamal Peninsula. Under the permanently frozen layers there is a gas hydrate zone which forms a thick dome, impermeable for free gas, extending along the shoreline. The concentrations of free gas and petroleum under the impermeable gas hydrate dome may be of practical importance. Allowance for existence of gas hydrate deposits in the upper part of the sedimentary cover increases the probability of finding significant quantities of petroleum and gas in this region. Figures 2, tables 1; references 22: 21 Russian, 1 Western.
[31-5303]

UDC 550.3

GRAVIMECHANICAL INVERSE PROBLEMS AND ISOSTASY

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 255, No 2, 1980 pp 309-313

MYASNIKC , V. P., FADEYEV, V. Ye., Moscow State University, manuscript submitted 9 Jun 80

[Abstract] A knowledge of the structure of convective movements in the deep layers of the earth would make it possible to obtain objective data for evaluating contemporary tectonic structures, the characteristics of stressed state of the lithosphere and the reasons for recent movements. The solution of this problem is closely associated with inverse problems in the theory of convection and gravimetry. The formulation of such gravimechanical problems is discussed in this article. The author has developed an asymptotic method for computing convective movements in the earth's deep layers (V. P. Myasnikov, et al., DAN, Vol 238, No 5, 1978; Vol 239, No 4, 1978; Vol 239, No 5, 1978). This method leads to a definite procedure for forming spatially uniformly-suitable approximations for geophysical fields. In further developing this line of research, the authors illustrate the principal characteristics of the method in the example of an analysis of the gravitational field of the planet, also taking into account that the derived expressions are used here in formulating inverse problems in gravimechanics. The formulation of the inverse gravimechanical problem and the isostasy concept do not require consideration of the properties of the asthenosphere and are correct even in its total absence. References: 3 Russian.
[34-5303]

STUDY OF RECENT VERTICAL MOVEMENTS OF THE EARTH'S CRUST (RVMEC) IN AZERBAIJAN BY GEODETIC METHODS

Baku IZVESTIYA AKADEMII NAUK AZERBAIDZHANSKOY SSR: SERIYA NAUK O ZEMLE in Russian No 2, 1980 pp 59-69

BUDAGOV, B. A., PIRIYEV, R. Kh., YASHCHENKO, V. R.

[Abstract] The first geodynamic polygon in Azerbaijan, on the Apsheron Peninsula, was established in 1910-1912. Its work program included study of recent vertical movements of the earth's crust. Thereafter a new geodynamic polygon was created in the neighborhood of Shemakhi for such studies both in individual local sectors and over the entire territory of the republic. Work also continues on the Apsheron Peninsula. These investigations show that the rate and direction of vertical movements vary over the area of the republic. In Azerbaijan an analysis of the curves of recent vertical movements shows that sectors of risings of the curves correspond to positive morphostructures and drops correspond to negative morphostructures. On the basis of statistical processing of the mean annual rates of RVMEC it was possible to determine their quantitative characteristics along the corresponding level lines (Table 1) and histograms of the distributions of the rates of RVMEC were constructed on the basis of these data (Fig. 1). The results of analysis of Table 1 and Fig. 1 made it possible to determine the pattern of statistical

distribution of the rates of RVMEC. On the territory of the Apsheron Peninsula, which is well studied by highly precise and precise leveling, studies have been made of rapid recent vertical movements of the earth's crust. A map of RVMEC (Fig. 3) of this important area was compiled for determining the nature of the spatial distribution of short-period crustal movements. In all these studies it was found that in investigating vertical movements of the crust repeated levelings, carried out over a short period of time (about 2-5 years), give more detailed material because they yield almost unaveraged indices of the rates of vertical movements. Repeated levelings, carried out over a great period of time, give excessively averaged indices of vertical movements of the earth's crust because the direction of movements in the period between repeated levelings can change, especially in seismically active regions such as Azerbaijan. Figures 3, tables 1; references: 15 Russian.
[52-5303]

UDC 550.834

DIRECT AND HELICAL WAVES FOR SOURCES AND RECEIVERS OF DIFFERENT POLARIZATION AND SYMMETRY

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 7, 1980 pp 91-100

AVERKO, Ye. M., Institute of Geology and Geophysics Siberian Department USSR Academy of Sciences, manuscript submitted 20 Nov 78

[Abstract] The article gives an analysis of the conditions for the appearance and registry of direct and helical waves of the longitudinal and transverse types for sources and receivers of different polarization and symmetry when carrying out both geophysical reconnaissance and exploration studies and also for different observation schemes for the purpose of optimum discrimination of the useful wave against the background of wave interference. In addition, the field in the space surrounding the borehole is considered for the case of a field created by borehole axisymmetric sources not emitting helical waves. The possibilities of suppressing helical waves and discriminating direct waves are examined. This involves the use of polarization schemes for making observations on the surface of the borehole. For example, in acoustic logging with direct transverse waves it is possible to use axisymmetric and symmetric sources of polarization φ with an observation scheme $\varphi\varphi$. In such logging with direct longitudinal waves it is possible to use sources of polarization z or r with observation schemes zz or rr respectively. Formulas are derived for the fields of displacement in longitudinal and transverse waves, expressed through the acoustic impedance of the oscillating surface of a long borehole experiencing radial, axial and tangential (azimuthal) axisymmetric motions. A study was made of the acoustic impedances of such boreholes and it was found that with borehole diameters greater than the wavelength these impedances coincide with the acoustic stiffness of the medium around the borehole. The attenuation of cylindrical waves of different types arising from the considered oscillations of the borehole surface is approximately identical; displacements in the distant zone of these waves differ insignificantly. Figures 2, tables 1; references: 12 Russian.
[61-5303]

UDC 550.834

SEISMIC TWIN WAVES

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 12, 1980 pp 44-52

GURVICH, I. I., Moscow Geological Prospecting Institute, manuscript submitted 24 Apr 80

[Abstract] In stratified media when observations are made along longitudinal profiles the totality of body waves can be divided into classes of symmetric and antisymmetric waves. Most of the useful waves are symmetric waves; the antisymmetric waves (twin waves) form most of the interference field. Thus, twin waves play an important role in seismic prospecting research. In particular, this relates to the wave field formed by deep interfering waves. (There are cases when twin waves can be useful waves.) Twin waves always have some significant characteristics which must be taken into account both in the solution of direct problems in the theory of seismic prospecting and in the analysis of experimental data. Inadequate attention to twin waves can lead to an incorrect identification of waves in interpretation, especially in the reflected waves method. It is clear that there is a need for a further, more detailed study of the properties of different categories of twin waves applicable to different methods and conditions for the use in seismic prospecting. Figures 7; references: 6 Russian.
[51-5303]

UDC 550.34.016

EARTHQUAKE PRECURSORS AND LABORATORY EXPERIMENT CONDITIONS

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 12, 1980 pp 30-43

SOBOLEV, G. A., Institute of Physics of the Earth, USSR Academy of Sciences, manuscript submitted 6 Aug 79

[Abstract] The article gives the results of laboratory experiments showing that the form and intensity of precursors of macrodestruction are essentially dependent on the spatial location of observation points relative to the orientation of a predicted fault and the main stresses. A study was made of the precursors of destruction in the velocities of longitudinal and transverse elastic waves and their ratio, in the field of deformation of the surface of samples and conductivity with different types of stressed state, rate of deformation and magnitude of hydrostatic and intrapore pressure. The results obtained in this study can be used in setting up field prognostic investigations in seismically active regions and interpretation of the results of observation of earthquake precursors. Figures 6: references 18: 10 Russian, 8 Western.
[51-5303]

UDC 528.242-525.14

RELATIONSHIP BETWEEN THE GLOBAL GRAVITATIONAL FIELD AND STRUCTURAL ELEMENTS OF THE CONTINENTS AND OCEAN FLOOR ACCORDING TO SATELLITE DATA

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 10, 1980 pp 3-12

FOTIADI, E. E., Institute of Geology and Geophysics Siberian Department USSR Academy of Sciences, manuscript submitted 30 May 80

[Abstract] Definite patterns revealed in a comparison of a model of global free-air gravity anomalies and major structural elements of the continents and ocean floor, as ascertained from satellite data, are discussed. Figure 1 in the text is a full-page map of global gravity anomalies and continental-oceanic bottom structures. Stable structures of the ancient platforms type and their shields on the continents gravitate toward negative global gravity anomalies. In the oceans such anomalies are associated with deep basins, for example, in the Pacific Ocean, with so-called thalastructures, isolated parts of oceanic cratons having an ancient basement. Folded zones, especially alpine regions of riftogenesis and epiplatform orogenesis, are associated with positive global gravity anomalies on the continents. In the oceans structures of young mobile zones, especially mid-oceanic ridges, gravitate toward zones of global gravity maxima. The long-wave nature of global gravity anomalies gives basis for assuming (with allowance for the computed depths to anomaly-forming sources) that processes in the deep mantle, in its transitional zone and especially in the Golitsyn layer, exert a considerable effect on formation of the considered structures. Figures 3; references 22: 20 Russian, 2 Western.
[32-5303]

UDC 550.831

STABLE METHOD FOR LOCALIZING HOMOGENEOUS GEOLOGICAL BODIES USING GRAVITY ANOMALIES

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 10, 1980 pp 89-98

BALK, P. I., Siberian Department USSR Academy of Sciences, manuscript submitted 10 Jul 79

[Abstract] The need for exploration of deep-lying ore bodies is increasing the requirements on the accuracy and detail of interpretation of gravity anomalies. The mathematical theory of interpretation is faced with the problem of creating a means for quantitative evaluation of the degree of reliability of the information extracted from the results of solution of inverse problems. Accordingly, the author proposes a method for determining the location of a local geological body based on an analysis (within the framework of the adopted model) of the entire set $\mathfrak{M}$ of admissible solutions of the inverse problem. In contrast to existing selection methods, in which the interpretation result is evaluations of the parameters of the model,

here the solution is a set of stably determined and geologically meaningful functionals. As explained in the article, these functionals are, in particular, the coordinates of the closed surfaces S_1 and S_2; the first of these occupies the volume Ω_1 which entirely occupies some part of the anomalous masses, whereas the second occupies the volume Ω_2, containing the entire region filled by anomalous sources. The application of the method is illustrated in three specific examples. Figures 5, tables 1; references: 4 Russian.
[32-5303]

UDC 550.8.053:519:553.98

JOINT ANALYSIS AND TRANSFORMATION OF GEOLOGICAL-GEOPHYSICAL FIELDS

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 10, 1980 pp 98-106

LOKHMATOV, G. I., GUSEV, V. A., KOBELEV, V. P., Irkutsk State University, manuscript submitted 11 Mar 79

[Abstract] In further developing the method of joint approximation of geological fields which the author proposed earlier (G. I. Lokhmatov, et al., "Joint Approximation of Several Geological Surfaces," SOVETSKAYA GEOLOGIYA, No 1, 1978), here he presents some modifications applicable to prediction of the structural plans of buried layers in petroleum and gas reconnaissance work. The earlier article outlined the advantages of the joint approximation method in comparison with known approaches to solution of the problem of predetermination of geological (structural) surfaces in a denser network of points with use of indirect information in the form of other studied surfaces and potential geophysical fields. In buried deposits the method assists in detecting promising bodies and strata promising for petroleum reconnaissance drilling under conditions when the density of geological-geophysical observations is nonuniform over an area and decreases with depth and the measurement methods are characterized by different accuracy and resolution. In continuing this work, the author describes two methods for transforming geological-geophysical surfaces in their joint approximation. The first method involves transformation of all the analyzed surfaces, and the second, only some of them. Figures 1; references: 4 Russian.
[32-5303]

UDC 517.944/947

THEORY OF PROPAGATION OF SEISMIC WAVES THROUGH A TECTONIC FAULT

Alma-Ata VESTNIK AKADEMII NAUK KAZAKHSKOY SSR in Russian No 10, 1980 pp 18-25

YERZHANOV, Zh. S., ZHUBAYEV, N. Zh., TLEUKENOV, S. K., BAYBULOVA, G. A.

[Abstract] A tectonic fault is usually not represented as a discontinuity of rock blocks but as a zone of fractured and ground rocks exhibiting viscous properties when seismic waves are propagated through it. Tectonic faults therefore must not be regarded as a discontinuity, but as anomalous layers situated between rock masses; at the boundaries of these anomalous layers the viscous friction phenomenon will be observed. In this article, with such a formulation of the problem, the authors investigate the laws of propagation of a plane normally incident transverse wave through a tectonic fault. The latter is modeled by an anomalous layer, whose boundaries interact in conformity to the viscous friction law, situated between half-spaces with different elastic constants. It is assumed that the velocity of wave propagation within the anomalous layer changes linearly. The first part of the article has a secondary character. It presents a detailed study of the consequences of incidence of a harmonic wave on the discontinuity of elastic homogeneous half-spaces and gives the derivation of the dependences of the coefficients of reflection, refraction and absorption of energy on the viscous friction coefficient. The second part gives a precise solution of the formulated problem of an anomalous layer between elastic homogeneous half-spaces. The amplitude-phase characteristics for reflected and refracted waves are determined. Figures 4; references: 2 Western.
[58-5303]

UDC 550.831

SOLUTION OF THE DIRECT PROBLEM IN GRAVIMETRY FOR SOME SPECIAL CLASSES OF MASS DISTRIBUTIONS

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 11, 1980 pp 45-61

LUCHITSKIY, A. I., LAPINA, M. I., STRAKHOV, V. N., Institute of Physics of the Earth USSR Academy of Sciences, manuscript submitted 4 Feb 80

[Abstract] In earlier studies (V. N. Strakhov, et al., DOKL. AN SSSR, 234, No 1, 1978; IZV. AN SSSR, FIZIKA ZEMLI, No 8, 1980; No 10, 1980) an analytical foundation was laid for solution of direct two-dimensional problems in gravimetry and magnetometry on the basis of the ideas of parametric stipulation of curves and expression of fields through elementary functions of the roots of algebraic equations. The purpose of this article is to use a number of important specific examples of practical interest and demonstrate how constructive this new approach is. However, the article deals only with the direct problem in gravimetry because solution of the direct problem in magnetometry in no way is different and allows

the same effective analytical approach to a solution. A solution of the direct problem is presented for those cases when mass density in a region is either constant or polynomial and the boundary of the region is described by algebraic polynomials whose degree is less than or equal to four or rational fractions. In this case the roots of the corresponding characteristic equations are expressed by means of radicals and the expressions for the complex strength of the gravity field give an effective solution of the direct problem in elementary functions. Figures 3; references: 10 Russian.
[44-5303]

UDC 550.831

METHOD FOR STABLE LOCALIZATION OF CHARACTERISTICS OF POTENTIAL FIELDS

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 11, 1980 pp 96-101

TROSHKOV, G. A., GROZNOVA, A. A., Scientific-Production Combine "Geofizika," USSR Geology Ministry

[Abstract] Solution of the inverse geopotential problem on the basis of the distribution of its partial derivatives (field elements) stipulated on some surface is the physicomathematical basis for mathematical interpretation of data from gravimetric and magnetic prospecting. This problem with a universality adequate for practical purposes can be solved by using the method of localization of the characteristics of external potential on the basis of data on field elements in the concept of singularities of analytical functions of a complex variable. The spatial distribution of characteristics, their type and the intensities of the sources situated at the singularities make it possible to obtain the principal characteristics of disturbing bodies of interest to geophysicists. The proposed method is applicable to plane-parallel and spatial fields. It is possible to increase the described localization method virtually without loss of its stability. Figures 1, tables 1; references: 16 Russian.
[44-5303]

UDC 550.831.01

DETERMINATION OF PARAMETERS OF MAGNETIZED BODIES UNDER COMPLEX FIELD CONDITIONS

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 9, 1980 pp 102-110

KALININA, T. B., BEZRUKOV, S. F., Scientific Production Combine "Geofizika," USSR Geology Ministry, manuscript submitted 29 Jun 79

[Abstract] The interpretation of overlapping (interfering) fields created by a group of magnetized bodies is very complex, but important in practical work. The accuracy of the evaluated parameters is essentially dependent on the degree of overlapping of fields. In platform regions their overlapping may be so insignificant that it is easy to discriminate local anomalies from individual bodies,

neglecting the influence of adjacent anomalies. However, in most geological regions, especially in areas where ore bodies are situated, the fields greatly overlap and the interpretation of the interference (allowance for the fields of adjacent sources) is completely necessary. A possible approach to solution of this problem has been developed (Yu. V. Andreyev and T. B. Kalinina, SEYSMICHESKIYE METODY POISKA I RAZVEDKI POLEZ. ISKOP., Kiev, Znaniye, 1974; T. B. Kalina, VOPR. RAZVED. GEOFIZ., No 5, 1968). The author in this article has further developed this approach, which is called the successive-separate method for the evaluation of parameters. It involves the successive interpretation of anomalies from individual bodies and their subtraction from the observed field. After the parameters of bodies falling within the limits of the observation profile are found the evaluations are refined: successive multiple repeated interpretation of the fields of each of the bodies is carried out, from which the fields of all the remaining sources with refined values of the parameters are excluded by subtraction. The total interpretation of field interference is thereby ensured. A partial interpretation is obtained in the case of a single evaluation of the parameters or with cessation of a repeated cycle of computations. Examples of interpretation of complex fields by this method are given. Figures 4, tables 1; references: 4 Russian.
[55-5303]

UDC 550.83(574+575)

COMPLEX CORRELATION ANALYSIS OF GEOPHYSICAL INFORMATION FOR STUDY OF THE DEEP STRUCTURE OF THE TURANSKAYA PLATE

Moscow BYULLETEN' MOSKOVSKOGO OBSHCHESTVA ISPITATELEY PRIRODY: OTDEL GEOLOGICHESKIY in Russian Vol 56, No 1, 1981 pp 30-41

KNYAZEV, V. S., KRYUCHKOV, V. P., MIKLYAYEV, V. I., PETRENKO, A. S., FLORENSKIY, P. V., SHRAYBMAN, V. I., manuscript submitted 28 May 79

[Abstract] Maps of correlation of the gravity and magnetic fields of the Turanskaya plate were computed on an electronic computer with different levels of generalization. The territory was regionalized on the basis of the determined characteristics of the correlation. A series of conclusions could be drawn which make it possible to re-examine some characteristics of its internal structure. Among these conclusions are the following. There is no unified character of the correlation over the entire Turanskaya plate, which reflects its heterogeneity. The territory is characterized by a complex and diversified character of the interrelationships between the gravity and magnetic fields. There are linearly elongated anomalies of a positive correlation of different strike, although WNW, NNE and meridional strikes predominate. The anomalies are associated with individual sectors of regional faults. Boreholes near them penetrate through basic rocks. These are probably sectors of deep faults along which basic magmatic rocks were intruded during the Permian and Triassic. The Karabogazskiy and Karakumskiy arches are regions with an absence of correlation. Regions with a different nature of geological development correspond to different types of relationship between the gravity

and magnetic fields. In zones where tectonic movements were actively manifested there is high correlation: negative in intensively downwarping, but positive in places where the movements were accompanied by magmatism. In areas where the earth's crust has been stabilized there is no correlation between the gravity and magnetic fields. Figures 4; references: 23 Russian.
[54-5303]

UDC 551.311

GEOPHYSICAL INVESTIGATIONS IN AZERBAIJAN

Baku IZVESTIYA AKADEMII NAUK AZERBAYDZHANSKOY SSR: SERIYA NAUK O ZEMLE in Russian No 2, 1980 pp 68-71

ISMAIL-ZADE, T. A., ISAYEVA, M. I.

[Abstract] The most recent achievements in geophysical work in Azerbaijan are reviewed and plans for future undertakings are outlined. For example, since 1980 specialists at the "Geofizika" Center have been carrying out research under the program "Development of Scientific Principles for the Search for Precursors and Prediction of Earthquakes." In carrying out these investigations plans call for development and mastery of production of a complex of instrumentation for implementing earthquake prediction investigations. Plans call for construction of a complex which includes engineering-laboratory and experimental-production buildings for a special design bureau for geophysical instrument making and an experimental plant for the production of geophysical instrumentation. A service is to be created for predicting earthquakes in the republic for predicting the intensity, place and time of occurrence of earthquakes. With respect to study of the sea and continental shelves promising for ore and nonore minerals, during the 11th and 12th Five-Year Plans there will be investigations on the inner shelf of the Caspian Sea, primarily for petroleum and gas. Various research programs are intended to increase the productivity of mineral exploration, production and transport work. During 1981-1985 specialists will carry out multisided studies for the development and introduction of fundamentally new methods for predicting and exploring for minerals, development of models of structure of the earth's crust and upper mantle in the republic. The scientific research at the "Geofizika" Scientific Center will be carried out in the following directions: formulation of the scientific principles for earthquake prediction; many-sided study of the earth's crust and upper mantle; development of automatic recording apparatus for making earthquake prediction investigations. While all these steps will be of great advantage to the economy of the republic, the improvements in earthquake prediction capability will be of exceptional importance.
[52-5303]

UDC 550.831

STRUCTURE OF THE EARTH'S CRUST UNDER THE MID-OCEANIC RIDGES IN THE TROPICAL ZONE OF THE ATLANTIC, INDIAN AND PACIFIC OCEANS

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 11, 1980 pp 62-73

BULANOV, V. G., BEREZHNAYA, L. T., VARLAMOV, A. S., TELEPIN, M. A., FEDOSEYEV, A. I., Soyuzgeofizika Trust, USSR Geology Ministry, manuscript submitted 5 Feb 79

[Abstract] On the basis of the results of gravimetric measurements made during 1973-1976 on the research ships "Dmitriy Mendeleyev" and "Akademik Vernadskiy" the authors made a comparative analysis of the deep structure of the axial sectors of the Mid-Atlantic, Arabian Sea-Indian Ocean and East Pacific Ocean mid-oceanic ridges. The quantitative interpretation of free-air anomalies was made in two ways -- using the well-known Nettleton method and the "Γ-block" program for an electronic computer. The latter is used in computing the distribution curve for the density of rocks in a layer bounded upward by the bottom relief of the ocean and downward by an arbitrary surface whose geometry can be known, for example, on the basis of seismic data. In order to judge the density content of the crust of such large formations as mid-oceanic ridges it is necessary to analyze the fine structure of the gravitational field, taking into account anomalies with an extent of 10-20 km and an intensity of 3-5 mgal. Thus, new information on the structure of the oceanic crust could be obtained only after carrying out surveys using sea gravimeters of the "Shel'f" series of the All-Union Scientific Research Institute of Geophysics. These highly precise surveys (error 1-2 mgal) then require subsequent interpretation. The principal conclusion drawn is that there is a density asymmetry of sectors of the crust situated on different sides of the axial parts of the rift zones. The upper parts of the oceanic plates, joining along the mid-oceanic ridges, have essentially different structural layout, density structure, and evidently, genesis. Accordingly, the mechanism of formation of the crust of the mid-oceanic ridges cannot be reduced to simple spreading symmetric relative to their axial parts. The axial parts of different mid-oceanic ridges differ from one another in significant details of deep structure. In particular, a considerable decrease in density of the crust to 2.3-2.5 g/cm^3 near the axes of the Arabian Sea-Indian Ocean Ridge and the East Pacific Ocean Rise indicates a considerable role of low-density, probably sedimentary-volcanic material in their section, covered only by a thin crust of basalts. There are also serious differences in the density content of the crust in sectors of the Equatorial-Atlantic Ridge. Some of the faults (Vema, Chain Trenches) developed in a thin oceanic crust in whose composition hyperbasites play an important role; on the basis of the structural characteristics they can be assigned to transformed bodies. Other near-lying faults have many characteristics making them closely related to typically rift sectors: a crust thickened to 20-25 km but reduced in density to 2.3-2.4 g/cm^3, absence of sediments and widespread occurrence of fresh basalts. Figures 5; references 11: 10 Russian, 1 Western. [44-5303]

UDC 550.348.098

TEMPORAL VARIATIONS OF PARAMETERS OF AN ACOUSTIC WAVE IN A ROCK MASS COMPLEX IN THE TERRITORY OF THE CARPATHIAN GEODYNAMIC POLYGON

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 11, 1980 pp 90-93

VERBITSKIY, T. Z., BOYKO, B. D., CHIGIN', A. I., Institute of Applied Mechanical and Mathematical Problems, Ukrainian Academy of Sciences, manuscript submitted 16 Jul 79

[Abstract] Seismoacoustic investigations in the territory of the Carpathian Geodynamic Polygon are carried out in a drift in Transcarpathia at a depth of 43 m. The acoustic sounding method is used on a constant base in a harmonic regime of elastic wave radiation. The source-receiver line is oriented in the direction of the studied component of linear deformation and the length of the measurement base and the frequency of the generated oscillations satisfy the requirements of measurements of the wave parameters in the distant zone. Measurements are made of the phase difference between the excited and the received oscillations, whose relative change is inversely proportional to the change in the velocity of propagation of an acoustic wave in rock between the source and receiver, and also the amplitude of this same wave, characterizing the dynamics of fissuring of the investigated rock mass. The relative error in measuring velocity and amplitude is 0.2 and 1% respectively, which should ensure reliable registry of changes in wave parameters caused by tidal and tectonic deformations of the earth's crust. A block diagram of the measuring system is given and briefly described. The analysis of the temporal variations of the speed of sound indicates that they have a broad and rather complex amplitude spectrum. Variations of velocity with periods of about 0.5, 1.0, 5.0, 9.5 and 14 days are characterized by anomalously great amplitudes. The presence of these periods is indicative of the influence of tidal deformations. The registry of changes in the speed of sound caused by tidal deformations of the probed rock mass indicates a high sensitivity of the seismoacoustic method for the monitoring of deformations and the possibility of its use in solving problems in geodynamics. Figures 4; references 9: 5 Russian, 4 Western.
[44-5303]

UDC 550.344

EXPERIMENT FOR DISCRIMINATING A PERIODIC SIGNAL FROM THE NUREKSKAYA HYDROELECTRIC POWER STATION

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 11, 1980 pp 94-95

VOLOSOV, S. G., Institute of Physics of the Earth USSR Academy of Sciences, manuscript submitted 9 Sep 78

[Abstract] It has been demonstrated in earlier studies that the spectrum of macroseismic noise contains sharp peaks at frequencies of several Hz. It was found that some of the detected quasiharmonic oscillations are associated with the operation

of hydroelectric power stations. The author therefore undertook a study of the possibility of use of industrial sources of harmonic oscillations, especially the quasiharmonic oscillation of the turbine rotor at the Nurekskaya hydroelectric power station for a study of the possibility of monitoring the stressed state of the medium near the dam and also study of geodynamic processes. This article describes an experiment for discriminating signals with frequencies $f = n \cdot 3.333...$Hz (where $n = 1, 2, 3, ...$; 3.333...Hz is the frequency of turbine rotation), whose source is the Nurekskaya hydroelectric power station. The oscillations were registered at the Langar seismic station situated 2 km from the power station. It was found that in the microseismic noise in the investigated region there are quasiharmonic oscillations at a frequency equal to the frequency of rotation of the power station turbine and in the harmonics of this frequency. The amplitude of the second harmonic is approximately six times greater than the amplitude of the oscillations with the fundamental frequency $f_0 = 3.333...$Hz. This fact must be remembered in investigations directed to interpretation of quasiharmonic oscillations from the Nurekskaya power station registered at relatively great distances (several tens of kilometers). Figures 1, tables 1: references 3: 1 Russian, 2 Western.
[44-5303]

UDC 550.343.2

MODEL OF EARTHQUAKE PREPARATION

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 11, 1980 pp 23-31

DOBROVOL'SKIY, I. P., Institute of Physics of the Earth USSR Academy of Sciences, manuscript submitted 4 Mar 80

[Abstract] At present there are many qualitative representations of earthquake preparation processes, sometimes satisfactorily explaining certain phenomena, sometimes encountering serious difficulties. This article examines another possible approach to the formulation of a general model of preparation and occurrence of an earthquake. The phenomenon is interpreted in general as a process of the genesis, development and decay of some local inhomogeneity. In the computation model the inhomogeneity is represented as a continuous inclusion with physicomechanical properties different from the properties of the surrounding medium. The author gives a detailed analysis of a case when a rigid inclusion is formed. From the physical point of view this essentially involves consolidation of a fragmented moving medium which is a model of some regions of the earth's crust. Within the framework of this model the author also computes the seismic parameters accompanying preparation of the Petropavlovskoye earthquake of 1971. Comparison of the theoretical results with field observations shows that in this case the model of a rigid inclusion leads to satisfactory agreement with experimental data. Figures 3; references 18: 12 Russian, 6 Western.
[44-5303]

UDC 550:551.24

PRINCIPAL SEISMIC ZONES OF PRIAMUR'YE AND PRIMOR'YE

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 9, 1980 pp 9-18

SOLOV'YEV, S. L., Institute of Oceanology USSR Academy of Sciences, manuscript submitted 25 Jan 80

[Abstract] Priamur'ye and Primor'ye are regions with a moderate seismicity level. Few earthquake data were available prior to the mid-1970's due to the thin settlement in the area, together with a total absence of regional seismic stations. The paucity of information on this subject led the author to compile a map of seismic events which have been registered in the region up to 1978. Such information is essential in connection with construction of the Baykal-Amur Railroad and the Zeyskaya and Bureinskaya Hydroelectric Power Stations. Most of these events were weak seismic tremors registered after the organization of three highly sensitive stations in the neighborhood of the Zeyskoye Reservoir in 1974-1975. A joint analysis of geophysical, geological and geomorphological data made it possible to discriminate 25 seismic zones in the region which differ in the character and intensity of seismotectonic movements. Each of these is described. The maximum magnitude of earthquakes in the Priamur'ye zones varies from 3 to 6, in the Primor'ye zones -- from 3 to 5. The maximum intensities are from 5 to 7-8 scale units. Figure 1 is a map of morphological elements and the strongest earthquakes; Fig. 2 is a map of the epicenters of known earthquakes 1865-1977; Fig. 3 is a seismic regionalization map. Figures 3; references: 35 Russian.
[31-5303]

UDC 551.243(470.34)

CLARIFICATION OF STRUCTURAL CHARACTERISTICS OF FAULTS IN THE VOLGA-URAL REGION BY MATHEMATICAL METHODS

Moscow GEOTEKTONIKA in Russian No 6, 1980 pp 34-41

BOGDANOVA, S. V., VAYNER, M. I., PETRENKO, A. S., EDUARDOVA, L. N., Geology Institute USSR Academy of Sciences, Institute of Geology and Regional Geophysical Research, USSR Petroleum Industry Ministry, manuscript submitted 21 Nov 79

[Abstract] The authors, applying multidimensional regression analysis procedures, developed a method for ascertaining the dips and horizontal projections of fault planes. It is based on a search for such a special arrangement of large sectors of geophysical fields relative to the matrix of geological parameters characterizing the crystalline basement for which the values of the multiple correlation coefficients are maximum. Data were obtained which were used for clarification of the morphostructural characteristics of the faults bounding the Al'met'yevskiy and Zhigulevsko-Orenburgskiy Archean complexes. The described peculiarities of the Kamskiy, Al'keyevskiy, Ural'skiy, Zhigulevskiy and other faults confirm that an overthrust model of their structure is the most probable. It was found that the faults have different dips, gentler in the sedimentary cover and steeper in the basement; this can be attributed to both different physical properties of

rocks of the sedimentary cover and basement and the temporal dynamics of fault development. The method and programs prepared for the detection of overthrust zones on the basis of a complex of geological-geophysical information make it possible to use them in a search for petroleum- and gas-bearing structures. Figures 2; tables 1; references 26: 25 Russian, 1 Western.
[40-5303]

UDC 55.034+699.841

MULTISIDED SEISMIC PROTECTION OF STRUCTURES AND CONSTRUCTION PROJECTS IN REGIONS OF HIGH SEISMICITY

Yerevan DOKLADY AKADEMII NAUK ARMYANSKOY SSR in Russian Vol 71, No 2, 1980 pp 104-110

MINASYAN, A. V., Institute of Geophysics and Engineering Seismology Armenian Academy of Sciences, manuscript submitted 11 Dec 79

[Abstract] In the course of oscillations of structures during seismic events there are frequently loads which cause partial destruction and plastic deformations. In order to ensure seismic stability of a number of highly important types of structures the author proposes a special type of seismic protection by means of i*, j* couplings. The first of these can be instantly destroyed, whereas plastic deformations will be experienced by the second. The theory and application of such a system are explained in detail in the example of oscillations of a multimass system in transient regimes with the assumption that the external effect conforms to any law of change with time and that the entire process is thermodynamically adiabatic. Expressions are derived which make it possible to ascertain the effects caused by damage to the couplings for any given form of oscillations or for any number of i*, j* couplings if the acceleration increment and the velocity of motion are known in a transient regime. A series of figures shows possible schemes for the placement of couplings. These schemes can be used successfully in the seismic protection of public buildings and in different structures in regions of high seismic danger. The problem of repair of the destroyed i* couplings is not dealt with in this article. As an example, computations are given for the seismic stability of a nuclear reactor. Figures 3, tables 3; references: 8 Russian.
[41-5303]

UDC 550.34.013

APPLICATION OF AN IMPROVED VARIANT OF THE ALSOP METHOD IN COMPUTING THE PROPAGATION OF A RAYLEIGH WAVE THROUGH A VERTICAL CONTACT

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 11, 1980 pp 87-89

MALISCHEWSKY, P., Central Institute of Physics of the Earth, Academy of Sciences GDR, manuscript submitted 30 Nov 79

[Abstract] A. L. Levshin and T. B. Yanovskaya (VYCHISLITEL'NAYA SEYSMOLOGIYA, No 9, Moscow, "Nauka," 1976) found that application of the Alsop method (JGR, 72, 3969-3984, 1967) involves considerable arbitrariness and proposed a new approximate method for computing propagation of a Rayleigh wave through a vertical contact. The author of this paper also endeavored to improve the Alsop method and obtained the same result as Levshin and Yanovskaya. The objective was to satisfy the continuity conditions at the vertical discontinuity as precisely as possible. The materials presented here are essentially a continuation of the author's earlier paper in PURE AND APPL. GEOPHYS., 117, No 5, 1045-1049, 1979. The computations were made with a Plexiglas-polystyrene model such as used by A. McGarr and L. E. Alsop (JGR, 72, 2169-2180, 1967). The results are compared in detail with the latest computations of T. S. Chen and L. E. Alsop (BULL. SEISMOL. SOC. AMER., 69, No 5, 1409-1423, 1979). Figures 3; references 8: 3 Russian, 5 Western.
[44-5303]

UDC 550.834.3/.571.1/+550.344.2

METHOD FOR SUBTRACTING MULTIPLY REFLECTED WAVES IN STUDY OF PALEOZOIC DEPOSITS OF THE WEST SIBERIAN PLATE

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 8, 1980 pp 58-69

ALEKSEYEV, A. S., KANAREYKIN, B. A., GORBUNOV, V. A., Computation Center, Siberian Department USSR Academy of Sciences, manuscript submitted 26 Dec 79

[Abstract] A study was made of the principal characteristics of the wave field of singly and multiply reflected waves (longitudinal and transverse) on a vertical profile obtained by solving the direct dynamic problem of vertical seismic profiling for plane waves and an ideally elastic medium. The theoretical wave field was computed from the acoustic section of one of the deep exploratory boreholes penetrating Paleozoic deposits with a thickness of 1.5 km in the southeastern part of the West Siberian plate. It was found that the ratio of the energy of a singly reflected wave to the energy of multiply reflected waves for Paleozoic discontinuities is approximately an order of magnitude less than the corresponding ratio for horizons situated in the lower part of the sedimentary cover. The same energy relationship is observed in experimental data. A method is proposed for suppressing the field of multiple waves in a time $t > t_x$, formed by the horizontally stratified part of the section in the interval $0-t_x$. The method involves the subtraction of

the field of multiple waves predicted on the basis of solution of the inverse and dynamic problems in seismics. The proposed method provides for an evaluation of the quality of solution of both the direct and inverse dynamic problems on the basis of the degree of coincidence of the theoretical and experimental wave patterns. The principal merit of such subtraction of multiple waves is that for its use it is sufficient to have observations along normal or near-normal waves and it is not essential to have multiple overlappings, which in most cases are used in the suppression of multiply reflected waves. Figures 7; references 19: 17 Russian, 2 Western.
[53-5303]

UDC 550.831

SOLUTION OF THE THREE-DIMENSIONAL DIRECT PROBLEM IN GRAVIMETRY

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 12, 1980 pp 53-74

STRAKHOV, V. N., LAPINA, M. I., KUCHERINENKO, V. A., Institute of Physics of the Earth USSR Academy of Sciences, manuscript submitted 31 Jan 80

[Abstract] One of the timely problems in modern gravimetry is the creation of effective (precise and economical) algorithms for solution of the direct three-dimensional problem in gravimetry. There are two principal approaches to solution of the problem: 1) creation of approximate (numerical) methods for finding the elements of fields from bodies of a regular geometrical configuration, with a constant or polynomial density, on the basis of the approximation and optimization concepts; 2) re-examination of the arsenal of precise classical analytical expressions for elements of fields from bodies of a regular geometrical configuration for the purpose of obtaining more economical (precise) solutions. The authors feel that the combined use of these approaches is entirely possible. At present gravimetrists are concentrating their attention on the first of these approaches and the second approach is not in good repute. The authors, however, feel that the possibilities of the second approach are greater than generally assumed. This article is devoted to a demonstration of this thesis. It is shown that the use of the theory of functions of a complex variable makes it possible to obtain new, substantially more economical analytical expressions for the g_z field from such classical bodies of a constant density as a horizontal material polygon, vertical polygonal prism, and some others. An attempt is also made to reveal the possibilities of a combined approach to solution of three-dimensional direct problems in gravimetry. The effectiveness of the new solutions is illustrated for the case of a thin material plate. Figures 4, tables 1; references 27: 25 Russian, 2 Western.
[51-5303]

UDC 550.834

MODELING OF THE PROCESS OF PROCESSING SEISMIC DATA

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 7, 1980 pp 101-110

MAKSIMOV, L. A., OBOLENTSEVA, I. R., TATARNIKOV, M. A., Institute of Geology and Geophysics Siberian Department USSR Academy of Sciences, manuscript submitted 21 Sep 79

[Abstract] The objective of this study is to demonstrate the need for modeling the process of processing of seismic data for evaluating the effectiveness of the processing algorithms and their correction. The authors present the results of experimental investigations carried out with the model of a salt dome. The method for carrying out these investigations is described in detail. It is shown that there is a need for a changeover to a digital method for the registry of parameters in ultrasonic modeling. The modeling data were processed on an electronic computer by the standard processing method. Total common deep point time sections were obtained. Using this material, it is shown that it is possible to evaluate and compare the algorithms for the processing of seismic data on the basis of the results of physical modeling. An example of the change in the standard summation method for the purpose of improving common deep point time sections is given. Figures 9; references: 2 Russian.
[61-5303]

COMMENT ON EARTHQUAKE PREDICTION

Minsk SEL'SKAYA GAZETA in Russian 11 Jan 81 p 4

[Article based on interview with A. Nikolayev]

[Excerpt] The earthquake prediction problem is difficult to solve because the physicochemical processes responsible for earthquakes cannot be studied directly. The world's deepest borehole, which is being drilled on the Kola Peninsula, has penetrated only to a depth of a little more than 10 kilometers. Earthquakes are being studied over the entire planet. Investigations have developed on a broad front in our country, although the territory of the USSR is not one of the most seismically dangerous. Only a fifth of the area of our country falls in a seismically active zone. Now the efforts of personnel of the geophysical institutes of the USSR Academy of Sciences, the academies in the different republics and the USSR Geology Ministry are being directed to implementation of the "Earthquake Prediction" program. Scientists are striving to detect the precursors of an approaching catastrophe. The fact is that on the eve of an earthquake some of the properties of the medium change in its focal zone. In the ground water there is a marked increase in the content of radon, helium and other gases.

This phenomenon was discovered for the first time by Soviet scientists. Other phenomena are also precursors: a change in the rate of deformation of the earth's crust, conductivity of rocks and the earth's magnetic field. Not one of these criteria can be considered universal. In many cases a precursor is observed but there are no tremors. In order to make a reliable prediction of an impending calamity it is necessary to take into account the entire complex of phenomena coinciding in time.

Seismic stations play an important role in predicting earthquakes. About 300 are operative in our country. They constantly monitor the physical processes transpiring in the earth's deep layers.

Prediction of the time and place of earthquakes is an exceedingly complex task. During recent years Soviet and foreign scientists have succeeded in predicting only a few underground tremors. But, emphasizes A. Nikolayev, section head at the Institute of Physics of the Earth, there is no doubt but that the problem will be solved.
[50-5303]

5303
CSO: 1865

PROBLEMS OVERCOME AND NEW DEPTHS REACHED AT SAATLY'S SUPERDEEP BOREHOLE

Baku VYSHKA in Russian 26 Nov 80 p 2

[Article by VYSHKA correspondent]

[Text] Our Party and government are every day devoting attention to the development of the fuel and raw material base of the country. The importance of uninterrupted supply of the national economy with fuel and energy was mentioned at the October (1980) Plenary Session of the CPSU Central Committee in a speech at the Plenary Session by Comrade L. I. Brezhnev.

The workers of the oldest petroleum province in our country, Azerbaijan, have been called upon to make their contribution to solution of this major problem in the national economy.

Today a VYSHKA correspondent tells about how things are going at important installations of the branch, whose construction is opening a new page in the development of the Azerbaijan petroleum and gas industry and the indices which personnel are achieving as the 26th CPSU Congress approaches.

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"Basalt," hissed master Mamed Mamedov through his teeth, pointing at the bit, whose superhard components in places were completely worn away, lying near the rotor. "It penetrated only 8 meters, whereas before it drilled through a thickness 5 or 6 times greater."

... Half a year ago the drillers of the depths from the Saatly Petroleum Exploration Expedition for Superdeep Drilling attained the 6-km level, thereby achieving the goal of the Tenth Five-Year Plan. And today the drill reached the 6,570-m level. In other words, the deepest borehole in Azerbaijan has already been drilled.

The path to this depth was by no means so simple. In order to safeguard themselves against any accidents, the investigators of the depths added to the drill tool a hydraulic shock mechanism -- a complex device making it possible to avert the catching of the pipes in the rocks and saving reagents for the chemical processing of the mud. And when at a depth of 6,450 m the drill hit basalt and the rate of drilling decreased sharply the engineers of the expedition became thoughtful. For successful drilling of the borehole to the planned depth one of the principal conditions is rapid finalization of the first stage in its drilling -- to the level

7,500 m, after which the geologists are counting on reaching the earth's consolidated crust.

A creative search and precise engineering calculations were carried out. At first it appeared that all the reserves for increasing the rate of drilling had already been exhausted. But somehow the chief engineer of the expedition, Nureddin Mamedov, had an idea: by long tradition a driller, regardless of the character of the rock, each quarter-hour raises the bit from the face and studies the interval which has been penetrated. Time is lost, the turbodrill and winch operate to no purpose and the cutter bearings are worn out more rapidly. And suppose all this could be avoided?

Nureddin Mamedov states: "At Azneft' [Azerbaijan Petroleum Administration] our proposal was first turned down flat. But we demonstrated its legitimacy by our actions. The depth of drilling with each bit was increased by a minimum of 14%. The saving from the introduction of this method was 135,000 rubles."

"Without question, in the success of the experiment a role of more than a little importance was played by other workers of the expedition, especially the drillers Ivan Trushelev and Paramon Tsaturov, their assistants Eminagi Ibragimov and Arzuman Kurbanov, the metal worker Isfendiyar Davudov, the electric assembly worker Boris Robyshev and many others."

"Still another problem arose at the unprecedented depth. It was related to rock sampling -- the taking of a core. The turbodrill makes several hundred revolutions per minute and the drill head of the core sampler requires 'quiet' rotation. It would be possible to rotate the core sampler unit by the rotor, but where is the guarantee that the already almost seven-kilometer column of pipes would hold up?"

"A solution of this problem was found in the form of a reducer developed at the All-Union Scientific Research Institute of Drilling Technology, introduced for the first time in the Saatly borehole. This reducer reduces the number of revolutions of the turbodrill to the speed necessary for taking the core. The very first core taken with this reducer was successful."

"The unusually hard rocks -- basalts -- cannot but exert an influence on the rates of work by the drillers. Nevertheless, the Saatly borehole was drilled to a depth of 6,500 m a year sooner than this same interval was drilled with the same drill rig on the Kola Peninsula."

These days the heat of competition is increasing among the personnel of the expedition for a worthy meeting of the 26th CPSU Congress.
[46-5303]

5303
CSO: 1865

KOLA BOREHOLE REACHES NEW DEPTHS

Baku VYSHKA in Russian 9 Jan 81 p 2

[Unsigned article]

[Text] After having drilled down to 10,600 meters, the drillers still have not reached the basalt layer that according to the current model of the earth's interternal structure should lie at this depth in this region.

"The Kola superdeep borehole is the first borehole in the world to break through to the discontinuity between the granite and basalt layers," related the Chairman of the Scientific Council for the Comprehensive Investigation of the Earth's Crust and Upper Mantle, Corresponding Member of the USSR Academy of Sciences V. V. Belousov. "To the surprise of the specialists, the very same rock which was extracted during penetration to the granite level was found below this mark. They have already drilled three kilometers beyond the earlier surmised level, but no rocks of the basalt type have been discovered. It was found that the rocks typical for the granite layer at this depth have the very same seismic characteristics as basalt. It is possible that this is the result of high pressure which developed there because of the pressure of the upper layers. In one way or another, the collected data are making it possible to improve significantly the interpretations of seismograms and their utilization for practical purposes. In the future we will surely have to adopt a more complicated model of the earth's crust."
[79-P]

CSO: 1865

'SKAT-77' AIRBORNE PROSPECTING UNIT

Moscow DOMESTIC SERVICE in Russian 0800 GMT 20 Jan 81

[Summary] Leningrad correspondent Leonid Polyakov reports from the "Geofizika" Association, where tests have been completed on the 'SKAT-77' integrated aerogeophysical station. A state commission has recommended that it be put into standard production. The station is used for the remote prospecting and detection of nonferrous, rare and noble metals. A candidate of geological-mineralogical sciences says that the association has formed an expedition consisting of four groups. Three of these are working in important ore-mining areas of the USSR -- in the Yakutskaya ASSR, at Norilsk, on the BAM in the Udokan ore-mining region and in Magadanskaya Oblast. As of this year a start will be made on testing and making practical use of the 'SKAT-77' station, which makes it possible to locate deposits from the air as it moves and checks what is in the depths of the earth. The head of the aerial geophysics section of the association says that the station is especially effective for the prospecting of ore minerals and nonferrous, rare and noble metals, particularly in remote and inaccessible areas.

Already in the next field season in 1981 the station will begin to give results. Its economic effectiveness is 500,000 rubles per year for every such station. The station is used in An-2 planes. The 'Skat' abbreviation means "Stantsiya Kompleksnaya Aerogeofizicheskaya Trekhmetodnaya" (Tri-Method Integrated Aerogeophysical Station). Its development began in 1977. The station has a tape recorder which registers the level of magnetic fields.
[49-F]

CSO: 1865

UDC 551.510.41:551.521.3:551.58

EVOLUTION OF THE EARTH'S ATMOSPHERE AND THE GREENHOUSE EFFECT

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 16, No 11, 1980 pp 1151-1162

KONDRAT'YEV, K. Ya., MOSKALENKO, N. I., Main Geophysical Observatory, manuscript submitted 13 Aug 79, resubmitted after revision 9 Apr 80

[Abstract] The greenhouse effect during different periods of the earth's evolution and long-term trends of its manifestation in the future are examined. Table 1 in the text gives information on the state of the atmosphere during its evolution. More than 2 billion years ago the atmosphere consisted of molecular nitrogen, carbon dioxide, simple carbon compounds, some quantity of ammonia, but no molecular hydrogen. As CO_2 was eliminated from the atmosphere-ocean system in the Urey reaction an atmosphere with a predominance of methane and nitrogen developed. The dissolving of methane in water limited the upper limit of its concentration. The photolysis of water vapor (after 800 million years) led to the formation of oxygen, which led to the destruction of ammonia and methane as a result of their oxidation. Approximately 2 billion years ago the primitive atmosphere ceased to exist and during this time 96% of the atmosphere consisted of molecular nitrogen. Approximately 420 million years ago the content of oxygen and ozone attained the level which made life on the land possible. The high surface temperature caused intensive evaporation and an almost continuous global cloud cover. The latter determined the great albedo of the planet and the low effective temperature during the first half of the earth's evolution. After the appearance of molecular oxygen, causing the oxidation of methane and ammonia, there was a rapid decrease in the temperature of the planetary surface and the ice caps were formed. The data in this table on the chemical composition of the atmosphere, variations of the solar constant, albedo of the planetary surface-atmosphere system and effective temperature make it possible, with known optical properties of atmospheric components, to examine in detail the influence of the greenhouse effect on the variation of climate in the process of evolution of the planet. On this basis the authors discuss the anthropogenic effects on the greenhouse effect and accordingly, the temperature of the planetary surface. The contributions to the greenhouse effect from different gas components in the present-day atmosphere, aerosol and upper-level cloud cover are computed. Figures 4, tables 4; references 21: 11 Russian, 10 Western.
[37-5303]

UDC 551.521.3

COMPUTATION OF RED ABSORPTION BANDS OF MOLECULAR OXYGEN

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 16, No 12, 1980 pp 1306-1308

VOYTSEKHOVSKAYA, O. K., SULAKSHINA, O. N., Institute of Atmospheric Optics, Siberian Department USSR Academy of Sciences, manuscript submitted 11 Jul 79

[Abstract] Magnetic-dipole transitions between the lower electron terms $^3\Sigma_g^- \to {}^1\Sigma_g^+$ form red absorption bands of oxygen. The absorption bands formed by the vibrational transitions $v = 0 \to v' = 1$ and $v = 1 \to v' = 2$ fall in the region 690 nm. Taking into account that the oxygen content in the atmosphere is considerable, it is necessary to estimate the contribution made by the rotational lines of molecular oxygen to the absorption of the radiation of a ruby laser. The parameters of the oxygen absorption lines necessary for a quantitative description were computed by a method proposed by J. K. G. Watson (CANAD. J. PHYS., 46, No 13, 1637-1643, 1968) for the transitions between singlet-triplet electron states. (The initial data necessary for computations of the centers of lines and intensities are given in a table.) A formula for the intensity of the lines in the band is presented. Using the proposed method the authors have developed an algorithm and prepared a program for an electronic computer making it possible to compute the centers and intensities of the lines formed by magnetic-dipole transitions of the red bands of oxygen. The results of the computations were compared with experimental data on line intensities and agreement within the limits ±5% was obtained. Figures 1, tables 2; references 15: 7 Russian, 8 Western.
[47-5303]

UDC 551.57:533.70:533.93

'PSEUDO-POWER-LAW' SOLUTIONS OF KINETIC EQUATIONS AND INTERPRETATION OF SOME SPECTRA OF PARTICLE SIZES OF ATMOSPHERIC AEROSOL, CLOUD AND RAIN DROPLETS

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 16, No 12, 1980 pp 1310-1312

SMIRNOV, V. I., SERGEYEV, B. N., Central Aerological Observatory, manuscript submitted 19 Oct 76, resubmitted after revision 27 Sep 77

[Abstract] In earlier studies (A. A. Lushnikov, V. I. Smirnov, TEZISY 8 MEZHDUNAR. KONF. PO NUKLEATSII, Leningrad, p 152, 1973; V. I. Smirnov, IZV. AN SSSR, FAO, 13, No 3, 1977) it was possible to obtain power-law solutions of the equations of stationary coagulation of aerosols in which the index of homogeneity λ of the coagulation coefficient K relative to the masses of particles is less than 1. On this basis an explanation of the Junge law was given. However, it is not complete because in the intervals of smallest particles ($r < 0.02$-$0.05\,\mu$m) and the largest

particles ($r>30\mu m$) the coagulation mechanisms are such that $\lambda>1$. In this article the authors have obtained and investigated a new type of solutions of the coagulation equations in which the limitation of the intervals of collisions is ensured by limitation of the interval of existence of the solution (spectrum of particle sizes). The determined "pseudo-power-law" spectra are analogues of the "nonlocal power-law" spectra in plasma theory whose existence has only been postulated (A. V. Kats, et al., ZhETF, No 1(7), 1976). The results presented here supplement the interpretation of the Junge law for aerosol and make it possible to explain some spectra of large cloud droplets. Figures 1; references 4: 3 Russian, 1 Western.
[47-5303]

UDC 551.501.71:621.375.826

POSSIBILITIES OF DETERMINING SMALL ATMOSPHERIC COMPONENTS USING LIDARS ON THE BASIS OF THE COMPARATIVE ABSORPTION METHOD

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 16, No 12, 1980 pp 1250-1257

GALKIN, S. V., MIGULIN, A. V., Moscow State University, manuscript submitted 19 Sep 79

[Abstract] Expressions are given for the transmission function in the case of propagation of radiation with a Lorentz contour through a homogeneous medium (a) with a single Lorentz absorption line and (b) with a Lorentz absorption line in a limited spectral interval. The centers of the emission and absorption lines coincide. It is shown that under definite conditions these transmission functions are equal to the ratio of the registered signal strengths during laser investigations of the atmosphere by the comparative absorption method. It was possible to determine the dependence of the content of the component to be analyzed along the path on the relationship of the generation and absorption line widths for different values of the transmission functions for a homogeneous medium with a single line. These dependences make it possible to evaluate the limiting possibilities of lidar systems and convert the experimental results into the sought-for concentrations of atmospheric components. The errors arising in determination of the concentration when the ratio of the registered strengths, that is, the transmission function, is expressed by the traditional exponential method. The influence of the finite width of the spectral interval in which the radiation is received on the determined transmission functions is taken into account. It is shown that a decrease in the interval leads to an improvement in the detecting capacity of the lidar. Thus, it is shown that it is possible to determine the concentrations of small components in the atmosphere by the comparative absorption method with arbitrary relationships of absorption and generation line widths and the spectral interval of the receiver. Figures 4: references 5: 4 Russian, 1 Western.
[47-5303]

UDC 551.501.7:551.510.42

MEASUREMENT OF THE CONCENTRATION OF GASES IN A HOMOGENEOUS ATMOSPHERE FROM THE ABSORPTION OF RADIATION OF A CO_2 LASER

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 16, No 12, 1980 pp 1303-1306

KHMEL'NITSKIY, G. S., Institute of Atmospheric Optics, Siberian Department USSR Academy of Sciences, manuscript submitted 15 Jan 79, resubmitted after revision 8 Jun 79

[Abstract] In this study of measurement of the concentration of gases in a homogeneous atmosphere on the basis of the absorption of radiation of a CO_2 laser it is shown that the expansion of the empirical vectors of the coefficients of attenuation in eigenvectors of the autocorrelation matrix and the finding of its eigenvalues makes it possible to: 1) ascertain the contribution to attenuation in the investigated part of the spectrum from different gases and to find the qualitative composition of the absorbing mixture by a comparison of the eigenvectors and the vector of the mass absorption coefficients and computation of the corresponding correlation coefficients; 2) using expression (6), derived by the author, select the most informative sounding wavelengths for each absorbing component under the conditions of a specific path; 3) compute the quantity of information on the absorbing component in the general attenuation coefficient, thereby determining the degree of reliability of the gas concentration values measured from the difference in absorption at several wavelengths; 4) detect and monitor the relative concentration of gases in the atmosphere in the absence of data on the mass absorption coefficients at the sounding wavelengths. Figures 1; references 6: 2 Russian, 4 Western.
[47-5303]

UDC 550.388.2

RELATIONSHIP BETWEEN PARAMETERS OF THE LOWER IONOSPHERE AND STRATOSPHERIC WARMINGS

Ashkhabad IZVESTIYA AKADEMII NAUK TURKMENSKOY SSR: SERIYA FIZIKO-TEKHNICHESKIKH, KHIMICHESKIKH I GEOLOGICHESKIKH NAUK in Russian No 6, 1980 pp 21-25

[Article by L. P. Korsunova and M. Shirmammedov, Physical-Technical Institute Turkmen Academy of Sciences, manuscript submitted 18 Mar 80]

[Text] An analysis of data from measurements of temperature and energy of stratospheric warmings [1] indicates the serious role of the high layers of the atmosphere in the forming and further development of these warmings. It is of interest to examine the behavior of the parameters of the lower ionosphere (D and E regions) during periods of stratospheric warmings.

Many studies have been published during the last 15 years in which a study was made of the relationship between absorption and stratospheric temperature. In most cases there is a good correlation between temperature at the levels 30-10 mb and the ionospheric absorption of radio waves, for which the ionospheric D-region is responsible [2-8]. At these levels a temperature maximum is observed with a lag primarily of 2-4 days relative to the absorption maximum, which made it possible to postulate the propagation of the disturbance in a downward direction.

A less clear picture is obtained when studying the behavior of parameters of the sporadic layer during stratospheric warmings. For example, in [9], on the basis of observations made in 1964-1965 in Brisbane, it was shown that there is a close relationship between sporadic E_s, cold fronts and microbaric activity. On frontal days E_s appears more frequently and its critical frequency is higher than on the remaining days. The screening frequency f_bE_s does not reveal such effects. However, according to data from two middle-latitude stations ("Yulius-Ru" and "Bekeshaba") it was possible to establish a close relationship between the parameters of the E_s layer (f_bE_s and $h'E_s$) and stratospheric warmings [10]. During a period of a warming the E_s screening frequency and its altitude increase.

During these periods there is also an increase in the intensity of nighttime radiation of the upper atmosphere [11]. According to observations at Abastumani during 1957-1970, the maximum of emission intensity is noted 3-8 days after the onset of warming at the 10-mb level. Simultaneous measurements of wind velocity in the ionospheric D-region and temperature at the 30-mb level indicated an increase in the wind velocity modulus with an increase in temperature [12]. The velocity maximum is observed 1-2 days later than the temperature maximum. The results confirm the presence of a close relationship between the dynamic characteristics of the lower thermosphere and changes in the meteorological parameters during periods of stratospheric warmings. However, as follows from the cited review, warmings are not always propagated in a downward direction. Evidently, disturbances of stratospheric circulation, leading to warmings, sometimes can also occur under the influence of tropospheric processes. For a better understanding of the physics of the transpiring phenomena it is necessary to study the interrelationship of processes transpiring at different altitude levels in the atmosphere.

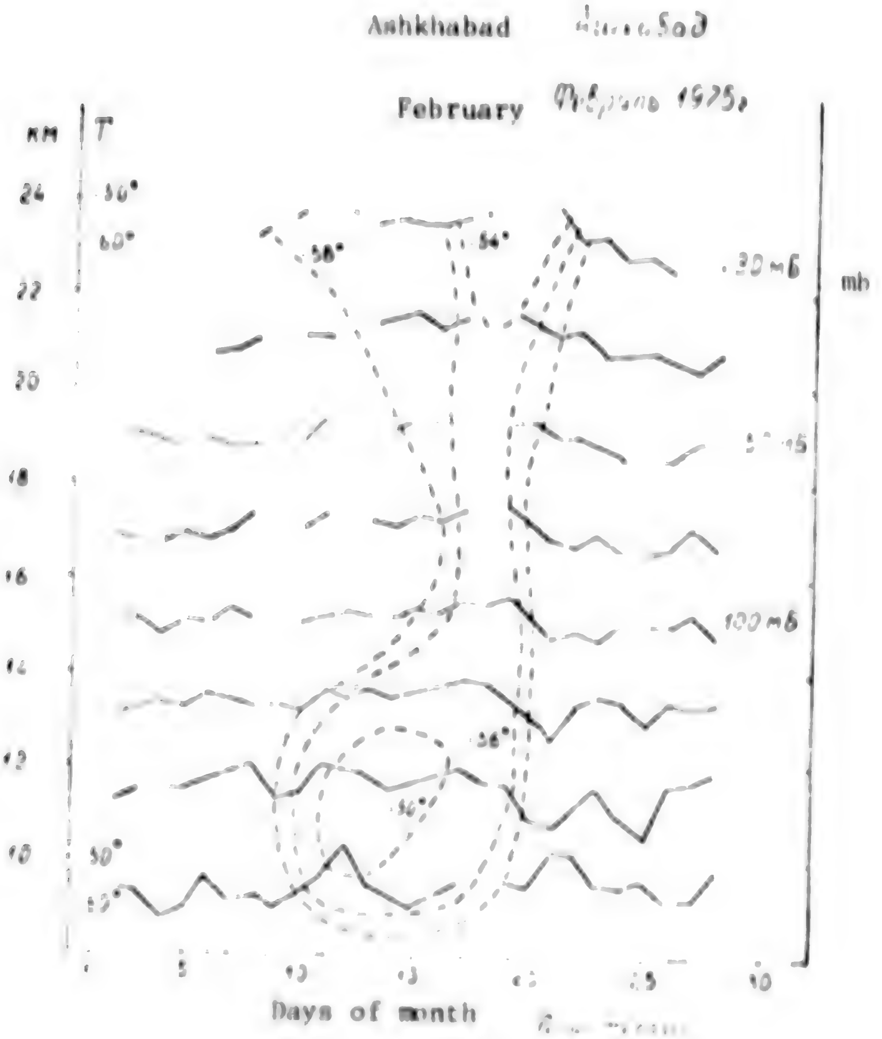

Fig. 1. Diurnal changes in temperature at altitudes 10-24 km.

For this purpose we examined changes in the principal parameters of the ionospheric E and D regions during periods of stratospheric warmings, bearing in mind that with constant external heliophysical factors these changes in the last analysis are caused by variations of the neutral atmosphere.

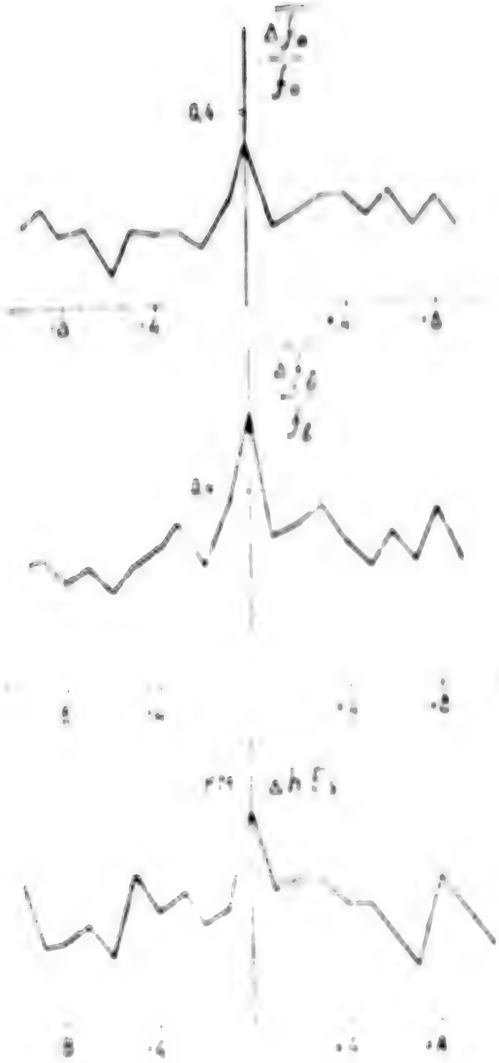

Fig. 2. Deviations of E_s parameters for periods of stratospheric warmings.

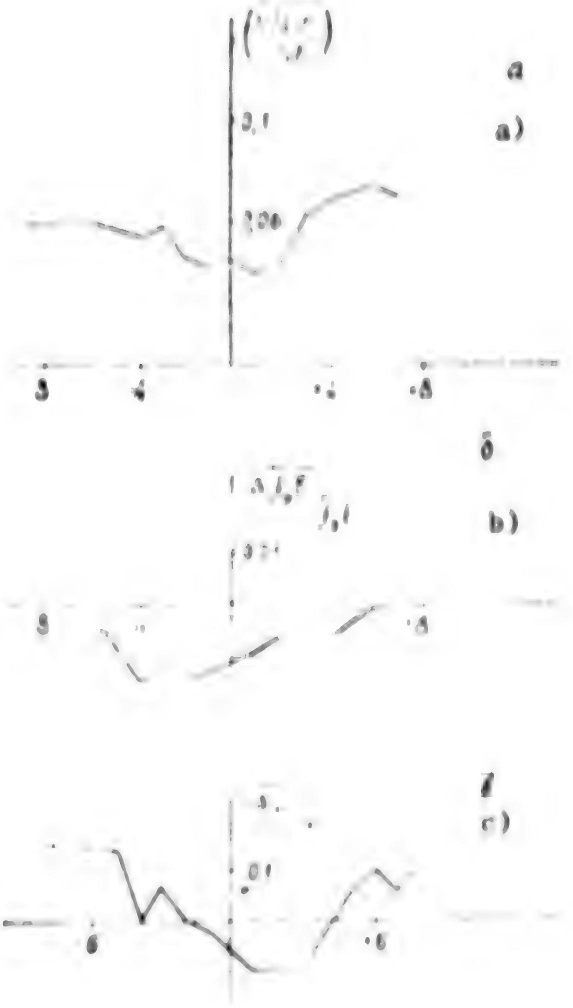

Fig. 3. Changes in the lower ionosphere during periods of warmings: a) range of semitransparency; b) critical frequencies of E region; c) radio wave absorption at f = 2.2 MHz.

In discriminating periods of stratospheric warmings we used data from aerological observations for altitudes 10-26 km carried out during the daytime hours in the winter months of 1974-1976 (from November through March) in the neighborhood of Ashkhabad. On the basis of these data we constructed monthly contoured maps of isothermic levels (Fig. 1), making it possible to discriminate centers of warmings in the mentioned altitude region. Since on the basis of the results of sounding over an individual station it is difficult to judge the direction of propagation of the warming, for a comparison with ionospheric data we examined the maximum temperatures at the levels 20 and 30 mb. Eight warmings were discriminated in this way.

In detecting the relationship between the parameters of the lower ionosphere and stratospheric warmings we used the superposing of epochs method. As the zero day we selected that when there was a stable maximum positive temperature change at the 30-mb surface. First we investigated the behavior of the sporadic E layer most closely associated with dynamic processes at altitudes of about 100-110 km. As the investigated parameters we took the mean daily deviations of the limiting frequency of reflections Δf_0E_s, screening frequency Δf_bE_s and virtual height $\Delta h'E_s$ from the median values. The changes in the mean daily deviations of the mentioned parameters over a period of 20 days, centered relative to the zero day, are shown in Fig. 2. All the E_s parameters are characterized by an increase on the zero day by a factor of approximately 1.5 in comparison with the control values. In order to check the truth of the correlation between the increase in the parameters of E_s and the temperature maximum at the 30-mb surface the result was checked for statistical significance. Using Student's test it was found that the increase in the mean daily deviation on the zero day exceeds the 2% significance level. Accordingly, it is possible to speak of a real increase in the parameters of E_s during the period of stratospheric warming.

The superposing of epochs method was also applied for such ionospheric parameters as the critical frequency of the E layer, characterizing the maximum electron concentration at altitudes 110-120 km, and the absorption of radio waves reflected from the ionosphere at a frequency of 2.2 MHz. Absorption at this frequency carries information on the state of the ionospheric D region, that is, on the electron concentration and the frequency of collisions at altitudes below 100 km. However, the electron concentration of regular regions in the ionosphere is controlled by the sun. Therefore, from the observed changes in the electron concentration it is necessary to subtract the quiet solar-diurnal variation. For this purpose we selected the values of the critical frequencies of the E region and absorption during those hours which correspond to a solar zenith distance $\chi_\odot = 60°$. These values were averaged in order to obtain the mean monthly value corresponding to $\cos \chi_\odot = 0.5$. Then we found the deviations of the observed parameters from the determined mean monthly value with $\cos \chi_\odot = 0.5$. The relative value of the deviations was then investigated by the superposing of epochs method. The results are presented in Fig. 3.

Since it was difficult for the parameters of the regular layers to establish a definite interrelationship to changes in stratospheric temperature due to the inadequacy of experimental data, it is only possible to speak of a tendency to a change in the considered parameters. In order to exclude the influence of random fluctuations the curves shown in Fig. 3 were smoothed by reckoning the moving five-day medians.

It was found that in the E-region the maximum electron concentration decreases at the time of stratospheric warmings; the maximum decrease is observed three days prior to the temperature maximum at the level 30 mb (Fig. 3b). Since the effect of radio wave absorption during the period of the winter anomaly is attributable for the most part to the electron concentration in the ionospheric D-region, it can be said that the latter also decreases at the time of warmings (Fig. 3c). However, the maximum of changes in the D-region is noted 5 days later than in the abovelying E region. It would seem that it is possible to speak of the propagation of some disturbance downward. However, the curve in Fig. 3a, representing the changes in the relative range of semitransparency of E_s, contradicts this assumption since the sporadic layer is observed precisely at the altitudes of the E-region. But the maximum decrease in the range of semitransparency of E_s is noted on the zero day. It must be recalled, however, that the changes in the range of semitransparency indicate directly a change in the dynamic regime of the turbopause and in particular, turbulence. However, changes in the electron concentration for the most part reflect changes in neutral composition caused by these same dynamic processes, but with some time lag.

In actuality, the curve in Fig. 3a shows that the turbulence intensity minimum is noted at the heating maximum: 6 days before and after the heating the intensity of turbulent transfer attains its maximum values. If it is assumed that $K_T = 4 \cdot 10^6$ cm^2 sec^{-1}, in the region 110-120 km the mixing time is $\tau = d^2/K_T = 3$ days. The changes in neutral composition -- of atomic and molecular oxygen, caused by a change in turbulent transfer, should be observed with such a time lag. With an increase in K_T the concentration of atomic oxygen decreases, but the concentration of molecular oxygen increases, which in the long run leads to a decrease in the electron concentration at these altitudes. In actuality, in Fig. 3b we see a decrease in the maximum electron concentration in the E region with a lag of 3 days. In the D-region this lag increases to 10 days due to a decrease in K_T in the vertical distribution, as is confirmed by the curve in Fig. 3c.

Summary

The intensity of turbulent mixing evidently decreases during periods of winter stratospheric warmings and the altitude of the turbopause increases somewhat.

The parameters of the regular layers also decrease in the investigated periods. The time of onset of the maximum of the effect is controlled by turbulent transfer processes.

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[64-5303]

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CSO: 1865

UDC 911.2:551.58

CORRELATION BETWEEN SOME CLIMATIC CHARACTERISTICS OF ANTARCTICA AND THE EARTH'S OUTER GRAVITATIONAL FIELD

Moscow IZVESTIYA VSESOYUZNOGO GEOGRAFICHESKOGO OBSHCHESTVA in Russian Vol 112, No 6, 1980 pp 489-496

RUDYAYEV, F. I.

[Abstract] It is postulated that a change in negative gravity anomalies to positive anomalies with time has resulted in a transformation of primarily cyclonic activity to anticyclonic activity (especially in eastern Antarctica). As a result, the quantity of precipitation falling in Antarctica was reduced and the further increase in the continental ice sheet was slowed. A figure in the text illustrates this phenomenon. To the east of the south pole, where the highest positive gravity anomalies are observed, the quantity of precipitation is close to zero. To the west of the south pole, especially in the region of negative anomalies, the quantity of precipitation is considerably greater. Similar geophysical conditions exist in the earth's northern hemisphere, in the Greenland region, where a thick continental ice sheet was also formed. (There are other hypotheses explaining the existence of the Antarctic Low and the origin of the Antarctic ice sheet, but these have not been demonstrated.) The considerations on the possible role of the outer gravity field in the formation of the Antarctic ice sheet presented in this article are significant in that there is no need for invoking any geophysical or other factors for explaining the paleoclimate of Antarctica not existing at the present time. It is the author's thesis that the formation of the ice sheets of Antarctica and Greenland could occur under conditions of atmospheric circulation and climate close to those existing on the earth at the present time. Figures 3, tables 1; references 5: 4 Russian, 1 Western.
[57-5303]

COMMENT ON 26th SOVIET ANTARCTIC EXPEDITION

Moscow PRAVDA in Russian 6 Jan 81 p 6

[Article by V. Serdyukov, head of expedition]

[Text] During the 25th anniversary of Soviet investigations in Antarctica two Soviet expeditionary ships, the "Mikhail Somov" and the motor ship "Bashkiriya," reached the Pravda Shore, bringing the next shift of winter workers and a group of researchers to the roughest and least accessible continent of our planet.

Summer is now in full swing in Antarctica and the polar workers are hurrying to take advantage of this period of favorable weather. By virtue of the breadth and extent of the intended plans and outfitting with scientific apparatus and transport equipment, the 25th Soviet expedition is the most impressive in Antarctica.

As in past years, intensive work during the short period of the Antarctic summer will be undertaken on the shores of the Weddell Sea and in the neighborhood of Mirnyy Observatory. Despite the difficult ice conditions, the diesel-electric vessel "Kapitan Markov" and the motor ship "Pioner Onegi" brought Soviet geologists and geophysicists, aviation equipment, tools and provisions to the seasonal station.

In the extensive regions near the shores of the Weddell Sea and the neighboring mountain masses geological and topographic-geodetic investigations have begun. A search for meteorites and glaciological investigations will be carried out. Crews of polar researchers have already arrived at Bellingshausen, Novolazarevskaya and Molodezhnaya stations. Here they have already begun preparations for the long and difficult Antarctic winter.

During the 26th expedition, the broad complex of investigations of the sixth continent will continue not only with the help of ground devices and instruments. The receipt of information from earth satellites and rocket sounding of the upper layers of the atmosphere will significantly expand our knowledge of the nature of the region which lies within the Antarctic circle.

An exchange of crews at Vostok station and Mirnyy Observatory will take place in the near future. The research ships "Professor Vize" and "Professor Zubov" are also maintaining course toward an enormous hydrophysical polygon between Antarctica and Australia, where work for an international program will be continued. The 26th Antarctic expedition is undertaking the next scientific watch of polar investigations.
[42-P]

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COMMENTS ON PAST AND PRESENT SOVIET ANTARCTIC INVESTIGATIONS

Moscow IZVESTIYA in Russian 4 Jan 81 p 6

[Article by V. Zakhar'ko]

[Excerpts] More than 15,000 of our scientists and specialists have participated in Antarctic expeditions. About 40 scientific institutes in the country, different ministries and departments are participating in the multisided study and conquest of the south polar region of our planet. And the expeditions which are formed are directed by the Leningrad Arctic and Antarctic Institute of the State Committee on Hydrometeorology and Environmental Monitoring.

The director of the institute, Corresponding Member USSR Academy of Sciences Aleksey Fedorovich Treshnikov, states: "It has been precisely during the last quarter-century that world science has learned most of the important information which is now available concerning Antarctica."

Some scientists have expressed the opinion that if the ice cover was to melt, the climate of the planet would improve. Let's visualize that some sort of furnace could be created and stoked. The water level in the world ocean would rise by 60 m and this means that all the gigantic coastal areas, especially densely populated, would be inundated. The intrusion of a 60-m layer of fresh water would change the entire established system of circulation of ocean waters and at the same time, the circulation of the atmosphere, and would cause a great many other unprecedented catastrophes. So let's not heat Antarctica; let nature take its course.

The work of the 26th Soviet Expedition is now in progress. Participating are about 1,400 scientists and specialists; 300 of them are remaining at seven stations for the entire year until the arrival of the next shift.
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